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The submarine is now an even greater potential menace to Britain and other countries dependent on overseas supplies. This would be true whether nuclear weapons were used or not. Submarines might be the carriers of such weapons. In any event nuclear motors would greatly increase the range of submarines. Future anti-submarine operations would inevitably call for large numbers of search-and-strike aircraft, first, because coastal defence requires continuous air patrolling and, secondly, so that convoys, endangered at sea, could quickly put up an anti-submarine 'umbrella'—off improvised carriers—in any weather. In heavy weather, submarines, moving through relatively calm waters, have a mobility advantage over surface craft and are, therefore, a greater menace. Britain and N.A.T.O. countries, already heavily taxed to pay for the last war and anxious to guard against a possible next, are turning to weapons like the Short Seamew, designed for fully effective performance in action yet within a nation's capacity to build quickly, cheaply and in large numbers.

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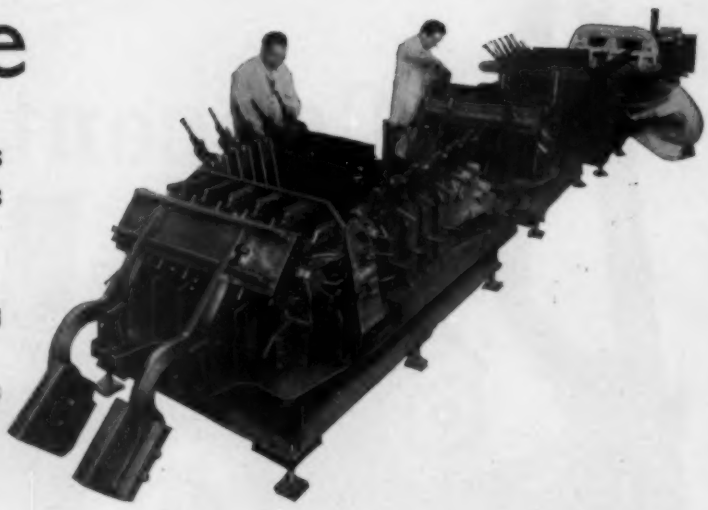

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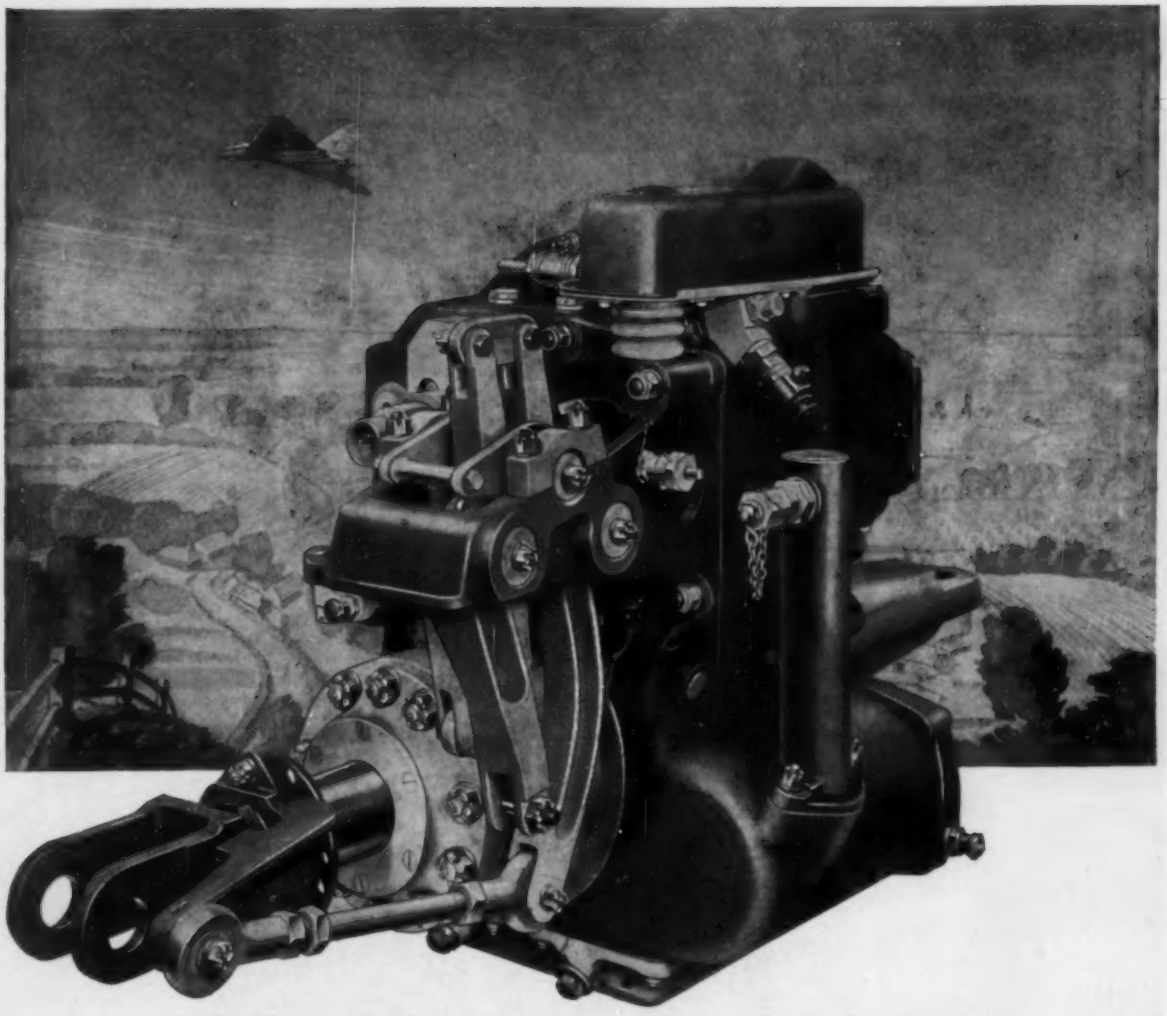

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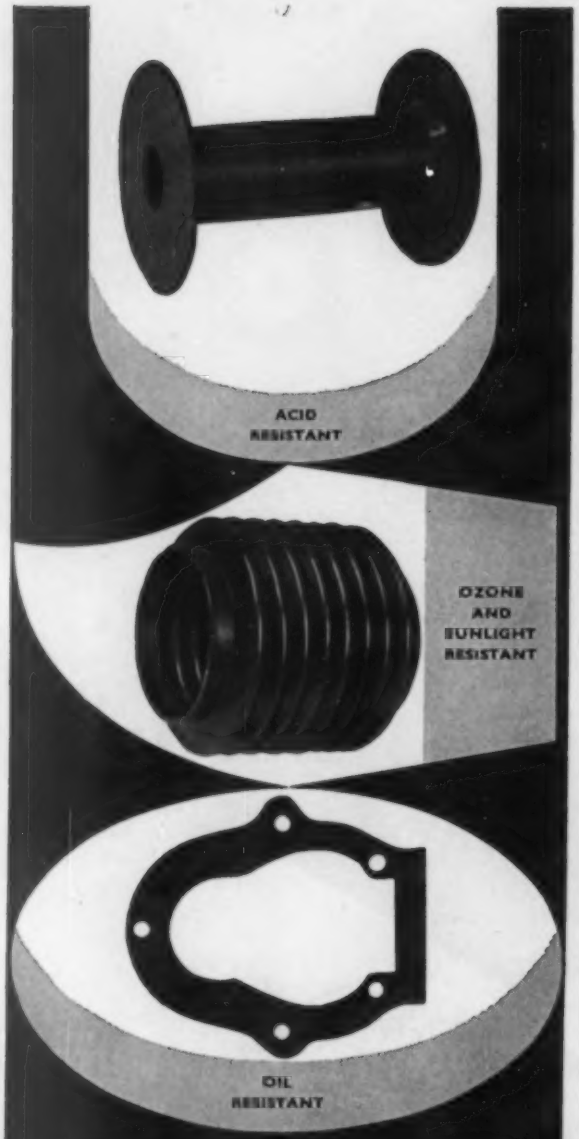

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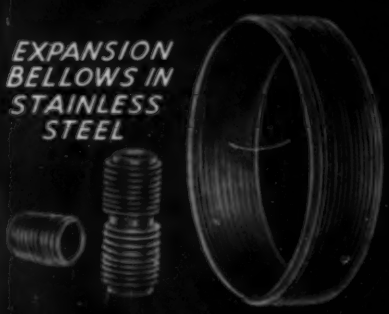

Left. JET ENGINE FLAME TUBE AIR CASING IN MILD STEEL

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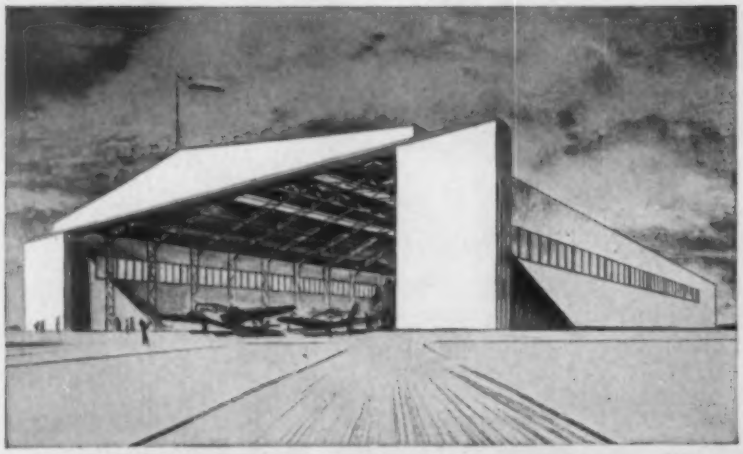

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and
AIRCRAFT ENGINEER

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The Mysterious Stranger

UNLIKE ships, aeroplanes in their element are seldom wholly amenable to disguise or camouflage. The most cunning dazzle-painting could never cause a Hunter to appear to be going astern; nor would the most imposing array of pods, turrets and radomes give a Canberra the air of a B-36. True, there have been numerous instances of mass deception in recent years, such as black-crossed Battles, asymmetric observation machines and butterfly-winged V.1s over England during the war. But people today are less easily deluded or bamboozled, especially if they dwell on the fringes of a busy airfield, and the testimony of a *Flight* reader that he has seen a strange type of jet aircraft over the Lakenheath, Suffolk, district must not be ignored. "In the sky," he says, "it looks like the war-time Horsa glider." He believes it to have one jet engine and reports a high tailplane, unswept wings of high aspect-ratio, and the ability to fly and climb at a very great speed. Another local report mentions a jettisonable undercarriage.

There we have clue number one.

Against this can be set a second—the seemingly guileless comment of a U.S.A.F. spokesman when questioned concerning the machine described. "It is not a combat plane," he said. "It is a high-altitude weather-research plane . . . being tested at Lakenheath as part of the programme for aeronautical research."

So the stranger is no apparition.

Clue number three (or have recent events over-stimulated our imagination?) is the disclosure in *Flight* of May 18 of a new aircraft known as the Lockheed U-2 which will cruise at a height of ten miles "as a matter of course." It is powered by a Pratt and Whitney J57 and is to be used for studying jet streams, for investigating turbulence and gusts, for examining air for cosmic ray particles, ozone —and radio-active content.

Another thrilling instalment next week?

Traffic in Olive Branches

FORTY years ago Lenin prepared an instruction manual for students of Communism with a title which corresponded roughly with the *International Standards and Recommended Practices* of the documents familiar to students of I.C.A.O. The most sinister annex contained the following three-point plan for Communist world domination: (1) provoke the enemy to the very threshold of conflict, (2) suddenly beguile him with repentant overtures of peace, (3) smash him down when his guard is lowered.

It may well be that Communism's technical committees, like those of the International Civil Aviation Organization, are constantly revising their recommendations in the light of changing conditions. If, however, Lenin's chilling plot is still unfolding according to the author's original plan, the world is now at Stage 2. But we believe that the West, without dropping its guard according to Stage 3, has nothing to lose by assuming that the present overtures are genuine. Western aviation, in particular, has everything to gain.

The Tu-104's recent skittish flittings to and fro, with payloads of vodka and caviare, between London and Moscow; the outstretching of Aeroflot's hand to Finnair, S.A.S., PanAm and B.E.A. (one of whose Viscounts is visiting Moscow next Tuesday with a party of travel agents); the invitation to the U.S. and British Air Staffs to attend the Soviet air display on June 24—all these are reminders of the rôle that aviation, particularly civil aviation, can play in the wealth and trust of nations.

But, as the world airline organization I.A.T.A. well knows—particularly when it comes to the *implementation* of the fares and technical services it recommends —the airlines are limited in action by governments. It is seven months since the chairman of B.E.A. was in Moscow to discuss an exchange of traffic rights—yet, so far, through travel from London to Moscow is by S.A.S. or Finnair. British civil aviation, we feel, should be free to trade on the new spirit, which can be tested for genuineness in no better way.

FROM ALL QUARTERS

Return Invitation Accepted

THE Air Ministry announced last week-end that Mr. Nigel Birch, the Air Minister, had accepted the invitation of Marshal Bulganin, the Soviet Prime Minister, to see the annual aviation day in Moscow on June 24.

The Minister, who is likely to be accompanied by members of the Air Staff, who are also invited, is to travel in a Transport Command Comet 2—an aircraft that is likely to cause as much interest in Russia as the Tu-104 did here.

It will be recalled that Marshal Bulganin and Mr. Kruschev, during their recent visit to this country, watched a special display staged by the R.A.F. at Marham.

Four More Britannias for R.A.F.

IT was made known on May 27 that the Ministry of Supply has ordered four more Bristol Britannias for Transport Command, bringing up to ten the total on order for the R.A.F. All ten aircraft are of the 250 type, which is a mixed version for both passengers and freight.

This latest contract brings the total of Britannias now on order to 55 aircraft. This total may be increased by five (ex-B.O.A.C.) 312s and ten 315s for Capital Airlines; according to American reports there is also to be a 400-series Britannia, with a length of 134ft, a wing of increased chord and Bristol Orion engines.

First M.o.S. Gnat

FIRST of six for the Ministry of Supply, Folland Gnat serial number XK724 flew for the first time on the morning of May 26. The chief test pilot, S/L. E. A. Tennant, expressed complete satisfaction with the aircraft; it was, he said, "like putting on a new suit that fits perfectly."

Each of the six M.o.S. machines is for evaulation trials with various types of equipment. The first aircraft is fully armed (two 30mm Adens) and equipped for operational duties. Apart from its Service livery the new Gnat can be distinguished by the slightly revised canopy and deeper fuselage to the rear of it (the top profile is now straight), which provides extra stowage space and also improves the aircraft aerodynamically.

Test flying is taking place from Chilbolton. Parts for the other five evaluation Gnats have been completed and assembly is now in hand. Meanwhile, discussions with several countries interested in the aircraft are continuing.

Nike Tests

FOR some years the Douglas Nike ground-to-air missile has been the centre of controversy. It has frequently been claimed that this U.S. Army weapon is obsolescent and cannot fully meet the threat of modern high-performance bombers.

Eight Nikes were fired recently in a test at White Sands, New Mexico, in the presence of Press observers. Only one target drone was destroyed but a number of splinter hits were scored. Lt. Gen. Mickelsen, commanding general of the Army Anti-Aircraft Command, said that the first shot registered splinter hits at 45,000 yd. This is almost 26 miles and is the greatest range yet officially attributed to the Nike. Nevertheless, there are many in the U.S.A. who are pressing for a full-scale evaluation of Nike against the Navy-developed ramjet-powered Bendix Talos—and possibly with other weapons, such as the Convair Terrier.

Canada's Big Fighter

SOME further brief references to Avro Aircraft's forthcoming CF-105 were made recently by Crawford Gordon Jr., president of the company. Powered by two of the new two-spool Orenda turbojets, the CF-105 will be a two-seat, all-weather fighter with a delta wing.

It will, said Mr. Gordon, be a "truly supersonic aircraft" reaching speeds far in excess of Mach 1 even in steep climbs. Unofficially it has been placed in the 1,500 m.p.h. class and is said to be heavier than a North Star airliner (82,000 lb). Kinetic heating at 1,000 m.p.h. would raise the temperature of the skin to about 250 deg F even at high altitude and the cockpit canopy would be made of laminated glass an inch thick. The valves in the various communication and control systems would be enough for 200 domestic TV sets and over 60,000ft of wiring would go into each aircraft. As for the fuel consumption, it would take 24 gal "merely to start the engines" and in a normal 40-min supersonic mission they would burn "as much fuel as the average motorist would use in six years"—or, we assume, as much as the average British motorist would use in twelve. At full speed the horse-power would be almost twice that of the *Queen Mary*, or something over 350,000 h.p. Another delightful quote from Mr. Gordon's address is that each control-surface jack "could move an elephant on the end of a 15ft beam through 40 deg/sec." The prototype is expected to fly next year.

First Canberra B.8 Exported

SIX months after the order was placed, the first of eight Canberras ordered by Peru left England on Friday last, piloted by Capt. J. W. Hackett, with Mr. P. J. Moneypenny as navigator.

A Mk 8, the aircraft is the first of this type to be sold abroad. It has standard equipment—no extra fuel tanks were fitted for the flight—and carries a gun pack containing four 20 mm cannon.

Though the delivery crew have made several fast Atlantic crossings by Canberra (including two which achieved three world records) this flight was planned as a more leisurely one, the route from the English Electric airfield at Warton being *via* Shannon, Gander, Baltimore, Montego Bay (Jamaica), Albrook A.F.B. (Panama), and Lima, at least one night being spent at each stop to arrange facilities for the remaining seven Canberras that will be delivered during the coming months.

Peru is the third South American state to buy Canberras. The Venezuelan and Ecuadorean air forces are already operating them.

Zürich's International Display

DÜBENDORF airfield, near Zürich, was the scene of a great air show last Saturday and Sunday. Aircraft and weapons from nine countries were there; and events were made the more exciting because the Americans made sure that they would have exhibits infinitely superior to any possible Russian participation. Not the most spectacular manifestation, but by far the most portentous, was the presence of five types of operational guided missile, Matador, Honest John, Corporal, Nike and the Oerlikon/Contraves ground-to-air rocket.

The Iron Curtain countries, for their part, apparently accepted invitations for an aerobatic team of three Zlin 26 Treners, the Tu-104 and some Russian fighters, but failed to send the fighters. American participation included the Skyblazers aerobatic team with F-86Fs, two F-100 fighters, two F-84F fighter-bombers, an F-86D, a Globemaster, B-47s, a C-119 and an H-19 rescue helicopter. The French were strongly represented by the Patrouille de France with Mystère IVAs, the S.E.210 Caravelle, the S.O. 4050 Vautour all-weather fighter, the Sipa Minijet and Coccinelle, the Max Holste Broussard, Fouga Magister, S.O. Djinn, Nord Noratlas and the Bréguet 901 sailplane. The Swiss themselves showed a great variety of privately owned American- and French-built light aircraft, the Pilatus P.3 and Swiss Air Force Venoms and Militia Vampires. The Swedes brought an aerobatic team of four Saab J-29Cs.

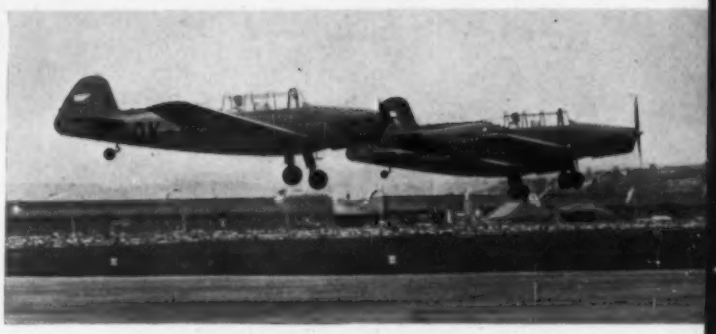
The show began with the ascent of the free balloon *Helvetia* and ended with the destruction of a mock factory by napalm and 20mm cannon-fire. The early part of the programme was devoted to the less spectacular items, but produced some magnificent performances, particularly the formation aerobatics by the three Zlin Treners, formation aerobatics by two Swiss Moswey III sailplanes and individual aerobatics of a quite exceptional quality from Major Liardon in a Bücker Jungmeister, by Häfliger in the Pilatus P.3, the Fokker S.14, the Magister and the Minijet. Of the four teams of jet aircraft which gave aerobatic displays, the best were the Swedish J-29s and the French Mystère IVAs. The Skyblazers did not quite achieve their customary incomparable form. Nor did the Hunters of No. 111 Sqn. come up to expectations. On the other hand, the spectators were probably not aware of the skill and hard work required to produce formation aerobatics. Bill Bedford gave a dashing show on a Hunter 6.

Among the very big aircraft the Globemaster could not fail to impress the Swiss by its huge bulk; the Tu-104, new to Switzer-

GNAT WITH TWO STINGS: This photograph of the first M.o.S. evaluation Gnat (see news item above) reveals the new, straight top to the fuselage. Also visible is a port for a 30-mm gun, with three anti-blast outlets, and a supplementary intake, at the wing root, which will be used for cooling electronics. A corresponding intake to port feeds ram-air for cockpit conditioning. Engine is a Bristol Orpheus.

"Flight" photographs

THE LUCKY SWISS: At Zürich last Sunday a crowd of half a million people were treated to an air display of quite exceptional quality. Among the demonstrations were tight and low aerobatics by the Fokker S.14 (above left), flown by test pilot J. Moll; two passes by the Tu-104 (above right), flown by Major A. Starikov; and startlingly fine formation aerobatics by three Czech Zlin 26 Treners, seen landing (right). Making its first public appearance in Europe was the F-100C Super Sabre, one of which is seen landing with airbrake and drag parachute out (lower right) during a preview in Germany last week.



land, also caused a great stir by making one fairly fast pass and another, without flaps, which was very slow indeed. The Caravelle was graceful, like the two Valiants, though these did not co-ordinate their performance. The Swiss were greatly impressed by an excellent, low, smoky fly-past of a "box four" of glossy white B-47s carrying their huge underwing tanks. Of the several sonic booms, those of the F-100s were biggest and best. The crowd marvelled gutturally at the thunder-clap as the F-100s simultaneously "kicked in" their afterburners and worked up a staggering rate of climb immediately afterwards.

Eight parachutists from three nations made descents and three among them used the Italian collapsible canopy. The subsequent descent looked like a "roman candle" and many a news-cameraman's mouth watered as he panned busily to record the sickening thud. It never came. The other jumpers used a new type of triangular canopy giving a very low rate of descent.

Altogether the Zürich meeting was a splendid affair almost overloaded with demonstrations of every kind and happily graced with perfect weather conditions and a perfect safety record. Some 160,000 people paid to enter the airfield precincts and an estimated further 240,000 covered the surrounding hill-slopes.

Overall brooded the silent automatons, Matador, Corporal and Honest John. But of these, and the rest, more next week.

Leadership in Training

SPEAKING at the Bristol Aeroplane Company's apprentice prize-giving last Saturday, Mr. Reginald Maudling, Minister of Supply, said that Britain had invested a great deal of money in the aircraft industry and his own view was that the country, by and large, was getting very good value from its investment.

Mr. Maudling discusses one of the machine tools with Mr. S. Crawford, workshop superintendent.

In face of a number of difficulties the industry's achievements, particularly in exports, had been really remarkable.

"All of us," he continued, "have extremely high hopes of the Britannia, which I believe may stand on the threshold of very great achievements. If it scores the success we hope it is going to do, it will be of the most immense significance, not only from the point of view of the company, but also from the point of view of the whole aircraft industry."

After the presentations the Minister opened a new £200,000 workshop for the apprentices. In introducing Mr. Maudling at the prize-giving, Sir Reginald Verdon Smith, the company's chairman, had said that there was nothing like it anywhere else in the country and it would set a lead for others to follow. It was an encouraging sign of the times that industry had welcomed the Government's White Paper on technological education. The Bristol Company had anticipated many of its recommendations and had already arranged to introduce next October a sandwich scheme of training under which aeronautical engineering apprentices would spend six months of each year on full-time technical study followed by six months' practical training.

The opening of the new shop marks the completion of the second stage of the Bristol Apprentice School, which was opened by Sir David Eccles, Minister of Education, in March last year. Housing some 80 modern machine tools, it has a floor area of nearly 30,000 sq ft. With these facilities and a staff of 24 instructors, it is designed to handle over 250 apprentices under training at one time.

Luftwaffe Officers to fly Hunters

DUE in Britain last Tuesday for an eight-day visit, during which they are to fly Hawker Hunters, were three highly decorated officers of the old Luftwaffe, who now hold prominent positions in the new West German Ministry of Defence. They are Col. Johannes Steinhoff, war-time leader of the Me262 fighter wing, and now responsible for fighter planning, operations planning and choice of equipment; Col. Kurt Kuhlmey, former fighter-bomber commander with 540 operational sorties, now in charge of fighter-bomber planning; and Col. Hrabak, a former Me109 squadron commander, till recently in charge of personnel recruitment.

In January these three officers completed an eight-months' comprehensive refresher flying course in America, starting with an examination in the English language. After their visit to Britain they plan to go to France to fly the Mystère.

Three other Luftwaffe officers, Majors Krupinsky, Barkhorn and Wehnelt, have been in Britain since January, re-training on Provosts and Vampires. These three will remain till next month, completing their course on Hunters.

Though the future Luftwaffe commander-in-chief has still to be named, its first general was appointed recently. He is Gen. Richard Heuser, a war-time staff colonel, who is now Germany's air representative at NATO. Previously he was head of the air planning group, now led by Col. Panitzki.

FORMATION AEROBATICS

From the Pilot's Angle: Some Basic Rules and Finer Points

By Sgt. Plt. THOMAS E. LAMPITT

MANY of the more imaginative spectators at air displays, watching formation aerobatics, must ask themselves "how is it done?" so often do the pilots seem to be achieving the near-impossible. In this article a member of the famous Hunter aerobatic team of No. 43 Squadron, which is currently appearing at displays both at home and on the Continent, describes some of the rules that must be observed if success—and safety—are to be achieved. The author, who has been flying in official aerobatic teams for three years, hopes that "this humble attempt to present the pilot's viewpoint may inspire an interest in formation aerobatics as an art in its own right."

IN an age when no major air show is complete without a display of formation aerobatics by jet fighters, it is regrettable that so few spectators appreciate the finer points of the "routine," or the problems confronting the pilots.

To many, the lower and more noisy the spectacle, the better the performance. This is a pity. Each year aircraft become more powerful and proportionately noisier, while minimum-height restrictions are rightly imposed for the public safety.

Unquestionably, the man with the biggest problems in any aerobatic team is the leader. Travelling at fully double the aerobatic speed of World War 2 fighters, he must smoothly fly the most complicated manœuvres, keeping the formation within sight of the crowd the whole time. Only in this way can he preserve the element of continuity so vital to a good routine. Most air displays take place on an airfield with one or more metalled runways. The crowd is invariably concentrated on one rather than both, sides of the runway in use, and is located in a relatively small area. Thus the runway itself is a convenient and easily visible reference point on which the leader can align his team. He is forbidden to fly over the crowd, or towards them, other than momentarily (in the course of a turn, for example). Usually there is a fixed minimum height for the aerobatic manœuvres and a second, lower, limitation for level runs past the crowd. These limitations are commonly 1,500ft and 500ft respectively.

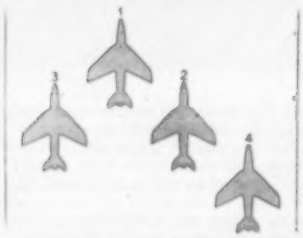


Fig. 1. "Finger starboard" take-off, as usually adopted by No. 43 Squadron's Hunter team on an average (150ft-wide) runway.

The leader knows his routine to perfection. It is fixed and to all intents and purposes inviolable—until the next week's display at least! He must therefore position the the team so that the central point of the routine is in front of the crowd, complying with the safety regulations at all times. The team will then travel much the same distance either side of this point, as they turn or wing-over between manœuvres. If this central point is too far away from the crowd, the aircraft will appear small and interest will be lost. If it is too near, the team will be almost vertically above their heads as it goes over the top of loops, and the spectators will have to indulge in much neck-stretching to follow them.

When the team is operating from the display airfield, a fresh problem arises: the best way to make the take-off and landing interesting (but not expensive). A team of four can take off in two pairs, as in standard operational practice, or with all four aircraft together. The latter course requires a minimum runway-width of four wing spans, because if any member of the team has to abandon take-off, owing to a burst tyre or engine failure, it is essential that the others have clearance to pass him

Fig. 2. The basic box formation, demonstrated by No. 43.

Fig. 3. "Echelon formation is more difficult to hold than is a box . . ."

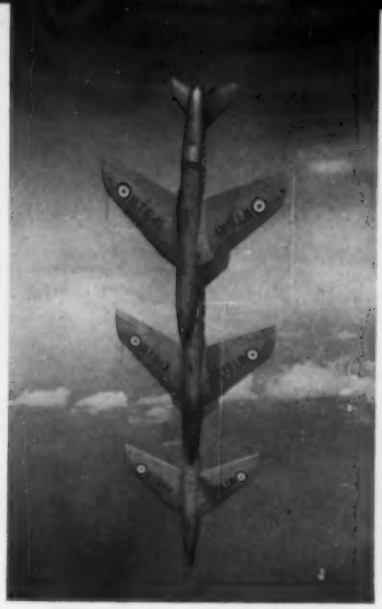


Fig. 4 (left). "This applies equally to . . . line astern." Fig. 5 (right). In a "flat echelon" turn each aircraft banks individually.

safely. The average runway width of 150ft works out nicely in this respect. The take-off can be in echelon, with the leader on the extreme left or right, and the others in logical numerical order. We (the team with which the writer flies) usually take off in "finger starboard" formation (Fig. 1). Immediately they are airborne, the leader turns port, and the No. 4 slides across into the "box" position (Fig. 2), ready to start the aerobatics. This formation change occurs at a very low altitude, often right in front of the crowd, and makes a good start to the routine.

If the team members merely had to maintain a steady box formation everything would be plain sailing. Modern standards, however, demand not only near-perfect station-keeping, but the ability to change formation during the most complicated manœuvres. These changes must be executed smoothly to avoid any impression of the formation breaking up, even momentarily. Echelon formation (Fig. 3) is more difficult to hold than is a box because any slight disturbance to the leader's aircraft tends to be exaggerated as it passes down the line, resulting in a definite "whip." This applies equally to line abreast and line astern (Fig. 4). There are, of course, variations on the basic formations. From box, it is an easy matter for the wing men to slide back to formate on No. 4, the "box man." This forms "swan neck" formation. A turn in echelon is usually made with the aircraft stepped up with the angle of bank, but alternatively they can turn in "flat echelon," each aircraft having rolled into the turn about its own longitudinal axis (Fig. 5).

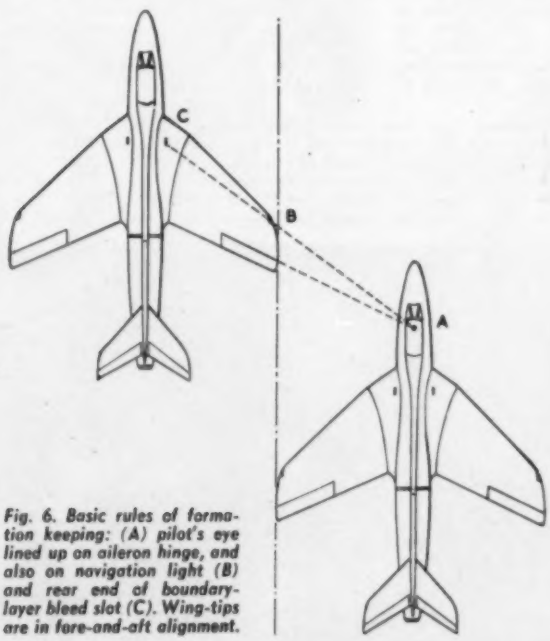


Fig. 6. Basic rules of formation keeping: (A) pilot's eye lined up on aileron hinge, and also on navigation light (B) and rear end of boundary-layer bleed slot (C). Wing-tips are in fore-and-aft alignment.

It may have been noticed that all the manœuvres mentioned have involved either roll, pitch or both. The rudder control is used very little in jet aircraft. Occasionally it comes in handy to correct a yaw which may develop if the formation goes over the top of a loop too slowly, near the stall. Again, if No. 2 gets too close in echelon, he will probably correct with a little rudder, rather than by the normal method of banking slightly away from his leader. In this way he is less liable to disturb Nos. 3 and 4, who are formating on him. Most of the time, however, the rudder could be locked solid for all it is used.

The correct formation position can be visualized if you imagine two aircraft standing side-by-side on the ground, with the nose of one a few feet further back than the other. Sitting in the cockpit of this second one, we study the appearance of the first. If the aircraft are Hunters, and if they are parked in the correct formation positions, you will be looking straight down the hinge line of the other's aileron (Fig. 6). The ground is level, so the aircraft are level, and you will notice that your neighbour's wing-tip projects well below the ventral surface of the fuselage. This is because of the characteristic anhedral of the Hunter. Your port wing-tip is on a fore-and-aft line with the starboard wing-tip of the other aircraft, but you cannot see that from your position. You can, however, see the position of the navigation light against the fuselage and get a picture firmly imprinted in your mind of the general apearance of the other aircraft. If one keeps all these reference points in their correct relative positions in the air, then one can be certain that one is flying the correct formation position in all three planes.

Line astern and box positions are easily checked in the air but not on the ground. I try to fly just below the leader's jet stream, laterally central, and with a couple of feet fore-and-aft separation of the verticals between my nose and the leader's tail-cone. This is to allow for a whip that might cause me to ride up relative to the leader. In the correct position I can feel his exhaust buffeting my rudder; at a high throttle setting this stream would flick my aircraft onto its back if it went fully into it.

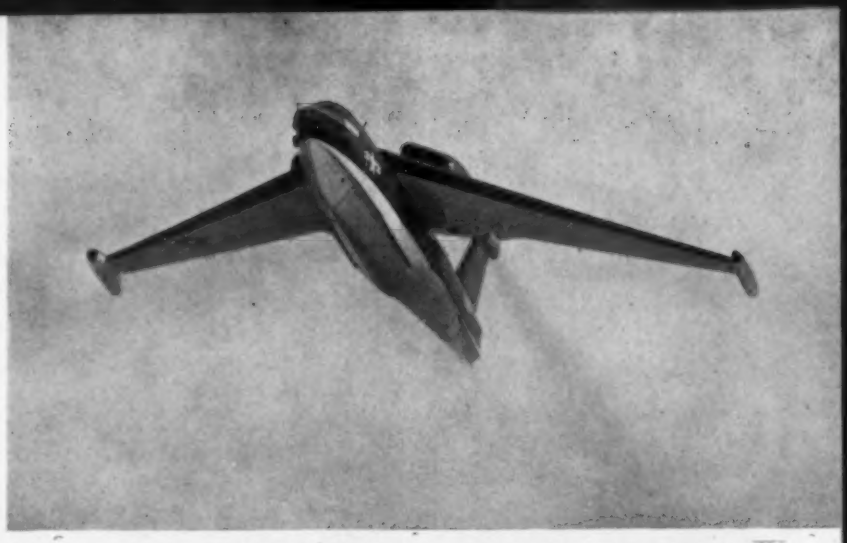
When an aerobatic team are "working up," they first practise single manœuvres such as loops and rolls, in one fixed formation. Later they progress to formation changes during these manœuvres. Only when each pilot is thoroughly proficient do they attempt to combine what they have learned and work out a routine. A good routine should, within the space of five to ten minutes, make the best use of both the potentialities of the particular type of aircraft and the ability of the individual pilots. All this practice is done at a safe height, usually between 6,000 and 10,000ft.

At this stage, all the team members are feeling confident and generally pleased with the way things are going. What a shock they have coming to them the first time they attempt the same routine at low level over an airfield! The leader suddenly realizes that he must turn far more steeply; must apply far more "g" to keep his formation over the airfield, within sight of the crowd. Loops become slower and tighter, to permit their execution under the minimum cloud-base. Rolls must be speeded up; wing-overs pulled round with up to 5 g. Small wonder that the recently impeccable formation becomes ragged in the extreme!

From then on the call is for practice and yet more practice.

(*Concluded on page 691*)

HERE AND THERE



FIRST FLIGHT of the second Martin XP6M-1 SeaMaster took place from Chesapeake Bay at the end of last month. It lasted 85 minutes; the pilot was George Rodney, chief of experimental flight testing. The first XP6M crashed on December 7 last; details of the causes have not been announced, but it is understood that they have been traced.

N.Z. Air League Formed

UNDER the chairmanship of Sir Matthew Oram, Speaker of the New Zealand House of Representatives—and an aviation pioneer—an Air League of New Zealand has been formed in affiliation with the Air League of the British Empire, and having a similar constitution and aims. A member of the Air League Council, A. Cdre. Sydney Smith, is leaving next week for the Dominion, where he will speak in support of the new organization.

Military Aircraft Reviewed

NO ONE who is interested in military aircraft should miss next week's issue of *Flight*, which will be a greatly enlarged special number containing a 60-page review, profusely illustrated, of the principal Service aeroplanes currently being produced by every aircraft-manufacturing nation. The machines will be arranged in categories determined by their tactical function, and each section will be introduced by a general discussion of trends in design and equipment. Readers who have not yet reserved a copy at their newsagents should do so without delay, as the demand for this valuable source of reference is certain to be heavy.

Ballooning Revival

TEN entries have been received for the Coupe Andries Blitz balloon race, which starts from Nijmegen, Holland, on June 24. Balloonists of seven nationalities are taking part, and among them is Mrs. Nini Boesman of Holland, who has already won the cup twice; with a third victory she would win it outright. Mrs. Boesman and her husband have made over 100 ascents; on Whit Monday they took their balloon to Eire (photograph, page 686).

Bradshaw Flying, New Style

CONTRACTS for the aerial mapping of 19 stations and many miles of track in the Southern and Eastern Regions of British Railways have been awarded to Air Survey Co., Ltd. The work, which has already started and is due to be completed early next year, is preliminary to a large-scale improvement scheme. The Air Survey Co. is a Fairey subsidiary.

Two to Note

SPECIAL numbers of Iliffe journals appealing to camera enthusiasts and motor cyclists respectively are appearing next week. On June 6 *Amateur Photographer* is pubishing its Camera Guide, containing a complete directory of cameras on the British market; and on the following day the Tourist Trophy Number of *The Motor Cycle* will appear, containing a full report of the Junior race.

The R.C.A.F. Comets

LAST week one of the two de Havilland Comet 1As of the Royal Canadian Air Force arrived at the makers' airfield at Hatfield, having left the plant of de Havilland, Canada, at Toronto on May 24, made a night stop at Goose Bay, and flown direct to Britain. It is now to be completely overhauled and modified—at the company's factory at Broughton, Chester—to the structural standard of the Comet C.2s of R.A.F. Transport Command, after which it will be returned to R.C.A.F. service. Its sister ship will be flown to England later this summer.

Bristol's Chairman

IN a reference last week to the annual general meeting of the Bristol Aeroplane Co., Ltd., the chairman's name should, of course, have been given as Sir W. Reginald Verdon Smith, M.A., B.C.L.

S.B.A.C. Educational Grants

THE Royal Aeronautical Society has drawn attention to the Society of British Aircraft Constructors' educational grants, which are administered by the R.Ae.S. These grants are designed for the assistance of young men who are unable, for financial reasons, to obtain training in aeronautical engineering. Recipients are expected to qualify for a technical grade in the Royal Aeronautical Society. Applicants should be between the ages of 16 and 18 on September 1 in the year of the award. The closing date for applications (to be made to the secretary of the R.Ae.S. at 4 Hamilton Place, London, W.1) for this year is June 30.

R.Ae.S. AWARDS were presented on the occasion of the Wilbur Wright Lecture. Last week we published photographs of Sir Roy Dobson and Dr. Hugh Dryden receiving their Honorary Fellowships and Sir William Farren the Society's Gold Medal. Six other presentations are shown below. On the extreme right is the new president, Mr. E. T. Jones, handing awards to (right to left) Dr. E. S. Moult (R.Ae.S. Silver Medal); Mr. J. W. Barnes (R.Ae.S. Bronze Medal); the son of the late Mr. "Joe" Smith, posthumously awarded the British Gold Medal for Aeronautics; G/C. W. K. Stewart (Wakefield Gold Medal); Mr. K. V. Diprose (Simms Gold Medal); and Mr. R. H. Woodall (George Taylor of Australia Gold Medal). Another recipient was Mr. J. Fenwick (British Silver Medal for Aeronautics). "Flight" photographs

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"FLIGHT" PHOTOGRAPHS

A Test Flight in the First American Airliner with British Turboprops

By C. M. LAMBERT

Handling the Napier Eland Airliner

INTENSIVE flying and development testing of the Napier Eland Airliner is now proceeding. This is the demonstration model of the Convair 340 turboprop conversion which Napiers are soon to show in America, and at the time of going to press some 150 hours have been flown, during which no major snags have emerged. Recently I had the opportunity to accompany Mike Randrup, Napier's chief test pilot, and his test crew on a 3½-hour flight to get the feel of this new powerplant/airframe combination. The flight was one of the series being made from Luton and Cranfield preparatory to a demonstration programme in Europe and America later this year.

The tasks on this particular flight were to carry out a series of "levels" at various altitudes, make a timed climb to 20,000ft and get 3½ hours' more Eland experience; and it was in the intervals between the specific tests that I was able to handle the machine. At the end of the flight I made the approach and landing. Since I had no previous experience of flying Convairs, the following notes are comments on the aircraft as well as on the Eland installation. Both are interesting to fly with, and in combination they add up to a potent aircraft. The new powerplant was described in *Flight* on July 23, 1954, and also on February 3 last, when some comparative data charts were also presented.

In arriving at the new conception Napiers made as few alterations as possible to the standard Convair airframe; the actual aircraft is one which was to have been delivered to Philippine Airlines. Thus one immediately notices that the engine instruments for the Elands are the same in size and number as those for the standard 2,400 h.p. Pratt and Whitney R-2800 CB16s. But there are fewer needles to watch; whereas the standard dials gave dual readings, the main Eland dials have only one needle each. Power-control levers are a little rearranged, a single lever sufficing for the Eland. In Convair style, everything in the cockpit is neat and the dominant colour is a fresh pale grey. Not standard are the numbers of oxygen tubes and economizers everywhere, but these are temporary and will be carried only until the pressurization is reinstated. The next Elands to be fitted will have the gearbox needed to drive the Convair's standard AiResearch cabin blower. Many of the seats in the passenger compartment have been removed to make room for a large data-recording panel, but here, too, normal airline appearance will be restored for the demonstration tour.

The Airliner had just landed at Cranfield when I arrived, and as soon as the turn-round was complete Mike Randrup, the test crew and I went aboard and prepared for the next flight. No time was lost. I took the co-pilot's seat and a quick look around. The hydraulically-operated forward staircase was retracted, using the electric stand-by hydraulic pump, and we were ready to go. A ground engineer on the tarmac checked the start-up and reported through an external intercom lead.

The cockpit picture overleaf shows the general layout of the "office." On the main panel engine instruments are in the middle. Power levers and some of the fine-pitch and feathering controls and elevator trim-wheels dominate the central console. Aft of these are the navigation and communication radio panels, flap and undercarriage switches and aileron and rudder trim wheels. Located close alongside the pilots, they are easy to reach and see. Some contact breakers and pressure gauges are positioned along a shelf below the main panel, and further controls, including the R/T. and intercom selectors, nosewheel steering wheel and pressurization controls, are on consoles along the cabin walls. The comfortable seats are adjustable fore-and-aft and in height. Radio reception can be put through loudspeakers just above each pilot's head, the need for wearing earphones thus being obviated during normal flying.

Preparations for starting are made in accordance with a long check-list which, in this case, is the one issued by Convair but modified where necessary for the different powerplant. The Elands now fitted give 3,000 e.h.p. each, but the Eland N.El.6, which is the proposed standard engine for the Convair, will give 3,600 e.h.p. and have an automatic starting system which relieves the crew of any gauge-watching or lever manipulation at this juncture. One of the engine's outstanding qualities is that it operates over a relatively wide band of r.p.m., but for normal flying the power delivery is reckoned from the torque reading (in pounds) rather than by reference to r.p.m. The actual power delivered can be calculated by multiplying the r.p.m. by the pounds of torque and multiplying the result by the constant 0.000561.

It is normal technique with the Convairliner to taxi with the control gust-lock engaged, using nosewheel steering and brakes. To engage the gust-lock, its lever is pulled back over the high-power segment of the power-lever travel, so that the application of more than moderate power is prevented; nothing like take-off power can be obtained with the controls locked. Visibility on the ground is excellent over a wide arc, but the pilot cannot quite see the wing-tip on the side of the aircraft away from him.

At the marshalling point Randrup went through the run-up procedures, which were essentially concerned with checking

Formating the Eland Airliner with the photographic Proctor was a difficult task for Mike Randrup, Napier's chief test pilot. The speed was about 120 kt and flap was necessary in the turn.

HANDLING THE NAPIER ELAND AIRLINER . . .

engine performance in relation to constant-speed settings and fine-pitch stops. During the first part of the take-off run I held the control column fully forward while Randrup steered with the tiller. At 80 to 90 kt, with 360 lb torque, he flew the Convair off and went straight into the characteristic steep climb at 120 kt. The undercarriage retracts forward and this speed should not be exceeded until retraction is complete. Climb power was then set at 220 lb torque.

We settled into level flight at the low-cruise power setting of 11,000 r.p.m. and 150 lb torque with a j.p.t. of 400 deg C, and the speed rose steadily past 125 kt to 170 kt. After cruising round for a few minutes we tried the impressive throttle response. The power lever can be pushed forward as fast as that of a responsive piston engine and the torque rises from 30 lb to 360 lb quickly and evenly and without any surge in temperatures. Noise level at the low-cruise setting was very low; at full power it was a good deal higher, but much of this was due to airstream noise around the windscreen. It is very difficult to judge the exact value of the noise level when power settings are constantly changed as they were during this flight. Later I went aft into the cabin and found that normal speech was perfectly audible, particularly right at the back. Installation of all the passenger seats, carpets and remaining trim can be expected to produce an even lower noise-level.

We had a date with a Proctor carrying *Flight's* photographer L. W. McLaren, who secured the accompanying pictures, and Mike Randrup worked hard for several minutes to formate at 120 kt with flaps up, both aircraft flying level and turning in close formation. I then took over and just flew the Convair about to get the feel of it. At 12,000 r.p.m. and 300 lb torque, the high-cruise power setting, the speed is 270 kt at about 4,000ft (the maximum normal operating speed), and the aircraft goes easily and noticeably "on to the step" to settle into a slightly nose-down attitude. A steady nose-up trim change during acceleration can easily be taken out with the low-geared but effective elevator trim control.

The Convair's control arrangement is typically American. According to the makers' brochure they have sought to produce minimum lateral stability coupled with maximum directional stability; but, because this causes some difficulties at low speeds with flap and undercarriage down, an interconnection is provided between aileron and rudder. Co-ordinated turns can thus be made at all speeds, using the aileron wheel alone. In addition, Convair have inserted a bungee spring to keep stick forces in the normal sense in relation to changes in speed. This provides the pilot with an immediate indication from the stick of any departure from trimmed speed. The bungee is arranged in the control circuit to produce a constant down-elevator force, and this effect is intended to be counteracted by the trim-tab setting to produce zero stick-force at any given speed. A decrease in airspeed from the trimmed position will reduce tab effectiveness and cause the pilot to apply a pull-force to supplement the loss of trim-tab force in opposing the spring bungee. In addition, the elevators are provided with servo tabs which assist the pilot only in moving the elevator upwards. Total stick-forces are thus kept reasonable. Finally, a bobweight on the stick provides an extra stick-forward moment whenever g forces increase significantly. The bungee is arranged with an over-centre mechanism so that stick loads are reduced for full elevator deflection. The result of all this in terms of handling is a very definite feeling on the stick of any change in speed. This in turn tends to produce fairly heavy stick-forces during medium or steep turns; and for comfort one tends to make ample use of the trim wheel.

American airworthiness regulations no longer require that a phugoid should damp itself out after a pilot has deliberately departed from a trimmed attitude. Though the Convair flies hands off indefinitely when trimmed, the phugoid resulting from an attitude displacement is not noticeably damped out, as the following figures show. They are the maximum and minimum speed readings at each climb or dive in one of the phugoids we produced:—235 kt, 175 kt, 230 kt, 172 kt, 232 kt. The rudder is light and rudder trim effective. Aileron trim is high-geared.

Control layout and presentation is very good in the Convair 340, and Napiers have made the minimum alterations for the conversion to Elands. Dominant colour is pale grey, a background from which instruments stand out very well and can be quickly read.

Engine dials are the same in size and number for the piston and turboprop powerplants, but the latter requires only single needles per dial. Prominent on the coaming are coffee cup holders and magnetic compass. Power levers, H.P. cocks, control gust-lock, fine-pitch stops and over-rides, and elevator trim wheels are on the forward step of the central console. Starter, fuel control, electrical and some radio panels are arranged in the ceiling. Radio, flap, undercarriage and aileron and rudder trim-wheels are on the aft section of the console.

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3. Barcelona's *the place for* Tortilla Española, *a colourful Spanish-style omelette.*
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6. *In* Amsterdam, Kalfoesters met Andijvie (*fried veal steaks with endive*) *are delicious.*
7. *In* Athens *try* Kebab — *mutton with chopped onions, bay leaves and tomatoes grilled on a skewer.*
8. *A great favourite in* Sicily *is* Coniglio in Agrodolce: *rabbit in sweet and sour sauce.*
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(Right) The Eland Airliner climbs away from the Proctor after the photographic session. (Below) The Airliner prepares for departure on the test flight from Cranfield described in these pages.

HANDLING THE NAPIER ELAND AIRLINER . . .

Randrup then climbed up to 9,700ft and throttled back and lowered 15 deg of flap. Trim was set for take-off at plus 1½ divisions and the aircraft brought back to the stall. At 88 kt there was severe airframe buffeting, but all controls remained effective as the aircraft stalled with the stick held back. A second stall came at 87 kt.

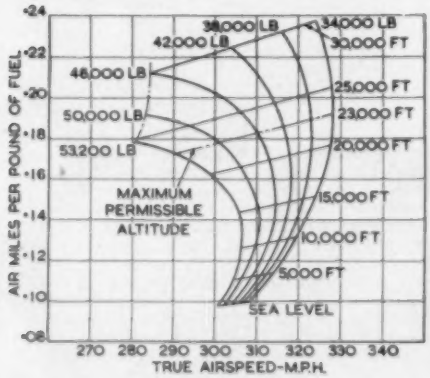
The engine-failure at take-off case was next tried, with both engines at full throttle at 95 kt and with the automatic feathering system disengaged to give the most disadvantageous (and unlikely) condition. The starboard throttle was then pulled fully back, but the yaw was not serious, control was easily retained and the climb continued with the aircraft trimmed "hands-off" at 135 kt, with the starboard engine still windmilling. We could go right back to the stall without losing control.

When Randrup closed the H.P. cock for the starboard engine and opened the throttle, the airscrew pitch coarsened automatically so that the airscrew revolved fairly fast but produced very little drag. The H.P. cock was then pulled back to the feathering position and the airscrew almost came to a standstill. Finally the feathering button was pressed and the airscrew stopped. These are the various degrees of feathering which can be selected, either to come in automatically in emergencies, or by manual control. Any one of them is effective in cancelling the drag of a windmilling airscrew. For the relight the H.P. cock was moved back to the "fuel off" setting, the feathering button was pressed and the cock opened fully. The engine picked up right away and the power lever was moved forward to give cruising power.

As mentioned above, one of the tests carried out during this flight was a timed climb to 20,000ft. With a constant 12,000 r.p.m. at 185 kt we started to climb from 2,000ft and the following figures show the indicated altitudes at various times after the climb was started: 1 min, 4,000ft; 2 min, 5,800ft; 3 min, 7,500ft; 11 min, 16,000ft; 14 min, 18,000ft; 17 min, 19,800ft. The whole climb took 17½ minutes and the fuel-flow gauges showed 105 gal/hr at the top of the climb. At 20,000ft, 12,000 r.p.m., 210 lb torque, 195 kt I.A.S., with an outside air temperature of −17 deg C, the fuel flow was 120 gal/hr. With the same power settings we then made a long, fast descent at 2,000ft per minute at 270 kt which is close to the aircraft's "don't exceed" speed.

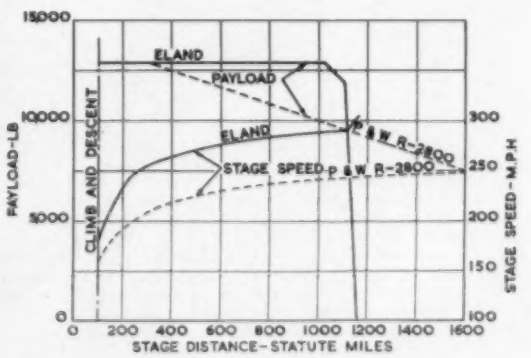
Finally we returned to Cranfield and I took over for the circuit and landing. Down-wind and base legs were pretty difficult to judge while making a left-hand circuit from the right-hand seat, because upward and rearward visibility are non-existent in these conditions; but I was "talked" to an initial point some two miles out and wheels and flaps were lowered. Both resultant trim-changes are very easily trimmed out and the initial approach was made at 100 lb torque and 120 kt. Control was a little sloppier than at cruising speeds but nevertheless quite effective enough to cope with turbulence. When full flap was lowered the aircraft took a pronounced nose-down set, which is slightly uncomfortable if one is not used to it. We cut power slightly short of the hedge and the resulting trim-change appeared negligible; the round-out was positive and easy. I aimed to land almost on three points, but this technique leads to a rather rougher touch-down than when the nose is held right up. Such a touch-down attitude does not come instinctively.

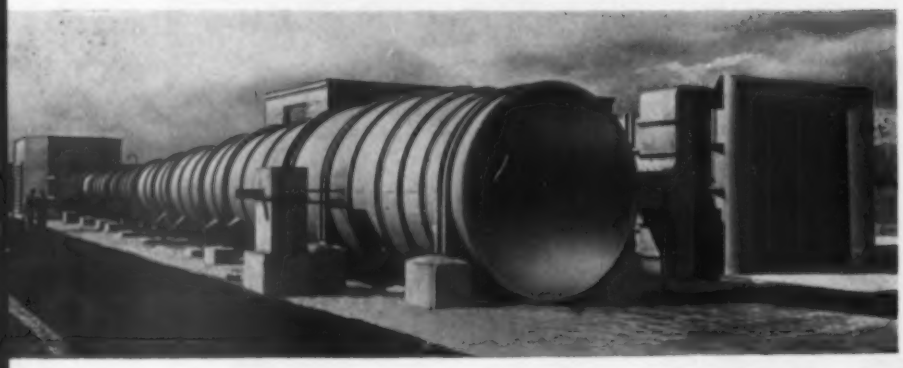
As soon as all three wheels were down the manual pitch-stop was pulled and both airscrews went into extreme fine, which gave a powerful and smooth braking effect. This procedure is very profitable in terms of reduced tyre- and brake-wear and is at least as effective as reverse pitch. It is also very impressive to the uninitiated. We hardly needed any brake before we were able to steer off the runway at one of the intersections, apply the control gust-lock and taxi back to the Napier hangar. As soon as we left the aircraft the flight observers began to make up their records and the ground crews got busy turning the aircraft round for its third flight that day.



(Left) Typical fuel consumption and T.A.S. curves for the Eland Airliner at cruising power in I.S.A. conditions.

(Right) Payloads in pounds compared with stage distance for a 15,000ft cruising altitude in the standard and the Eland-powered Convair.





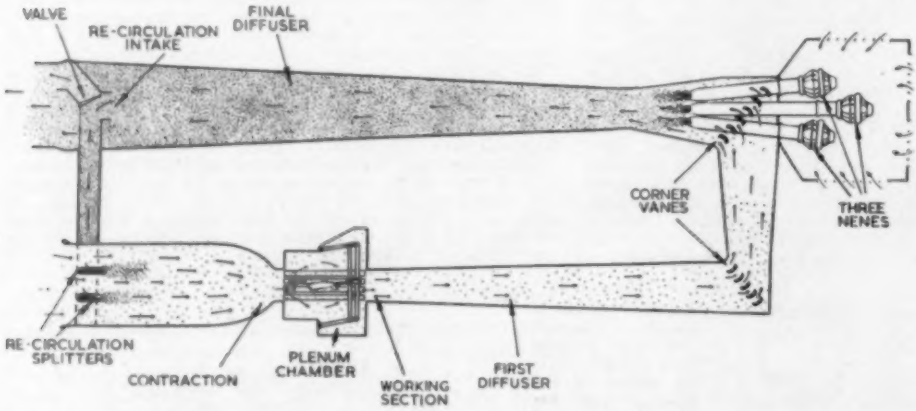
On the left can be seen the jet outlet and the square intake bell-mouth. The tunnel structure was manufactured by Harland and Wolff, Ltd., in welded and bolted steel sections.

Below is a view of the main control room. On the extreme right of the photograph is the control panel for the three Nene turbojets.

NEW TUNNEL AT BELFAST

MODEL testing at Mach numbers up to 1.2 is now being carried out in the new high-speed tunnel of Short Brothers and Harland at Belfast. As the flow diagram shows, the facility is of the open-circuit injector type, power being supplied by three Rolls-Royce Nene turbojets.

These engines are mounted in a louvred house at the second corner of the tunnel, and the outer pair are slightly toed in so that the centre-lines of all three engines meet at the end of the parallel mixing section. The ejector pump has an area ratio of 0.35, and at M=1.2 is working at a mass-flow ratio of about unity. At the end of the final diffuser is mounted a horizontal aerofoil incorporating a ram intake through which a proportion of the hot exhaust is carried across to the intake side, to prevent condensation. The gas enters the intake duct through vertical splitters and can raise the stagnation temperature to as much as 90 deg C, with a re-entrainment of about ten per cent.



A simplified flow diagram. Points of particular note are the circular-arc corner cascades, the re-entrant flow for a proportion of the hot exhaust gases and the plenum chamber surrounding the slotted working section. The performance of the tunnel was exhaustively checked by a one-twelfth scale model.

The intake bell-mouth is 11ft square and is some 28ft from the start of the contraction. The latter has a length of 13ft 2in and a contraction ratio of 19.35. It leads into the working section, which is 2½ ft square. Each of the four walls of the working section has four 0.833in-wide slits, 6ft 1½in in length, with an open: total-periphery ratio of 1:9; it is estimated that the length of uniform flow at M=1.2 should be about 18in. The working section is surrounded by a plenum chamber (about 1ft from the nearest part of the wetted face of the central slats in the side walls) into which the flow through the slots is induced by diffuser suction.

With highly swept wings the maximum span for interference-free flow should be about one foot, but straight wings of 18in span may be accommodated at M=1.2 provided that the subsonic corrections are not excessive. The Reynolds numbers attainable will vary up to about 4×10^6 per foot at M=1.2. Models are mounted inverted on a simple sting carried on a parallel linkage, free for 360 deg in roll and from −50 to +20 deg in pitch. Forces and moments are to be measured by conventional strain-gauge bridges with readings taken on an Elliott Brothers console. This console will also carry the tunnel-temperature control, dials for pitch and roll settings and a schlieren viewing screen.

For the future, it is expected that running time—expensive with a turbojet tunnel—may be saved by an increase in automaticity. This will involve the provision of digitizers on all measuring gear and the use of some form of mechanical pressure-sensing device. With very rapid recording, it may be worth while incorporating automatic Mach-number control. The design of equipment for measuring all oscillatory derivatives is also being investigated and it is hoped to make these measurements on the complete models used for static tests.

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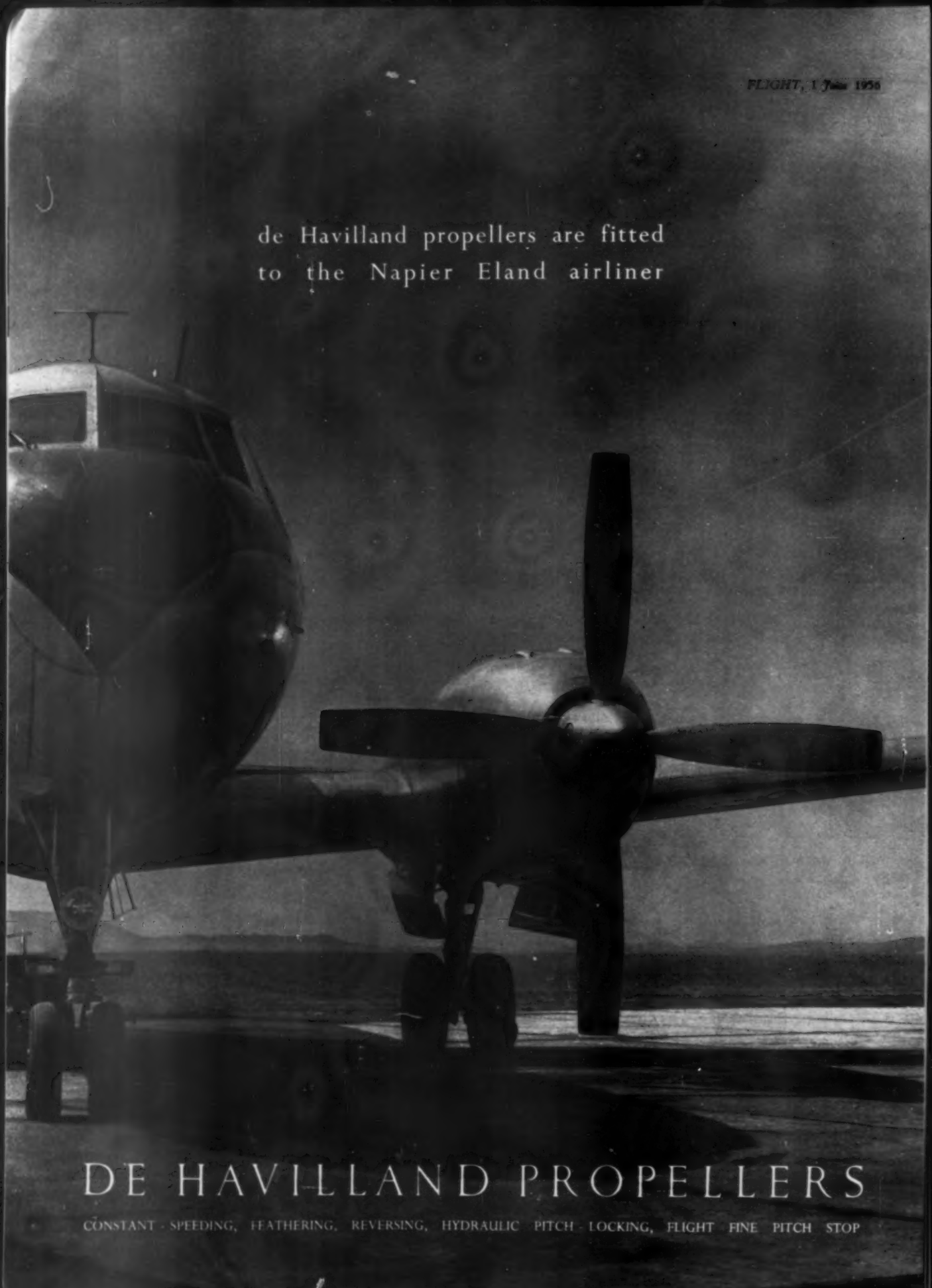

de Havilland propellers are fitted
to the Napier Eland airliner
DE HAVILLAND PROPELLERS
CONSTANT-SPEEDING, FEATHERING, REVERSING, HYDRAULIC PITCH-LOCKING, FLIGHT FINE PITCH STOP

A "Flight" artist's impression, prepared from the latest manufacturer's drawings, of the Vickers-Armstrongs V.901 Vanguard.

VICKERS VANGUARD

Preliminary Details of Commercial and Design Characteristics

IT has become customary, when talking of airliners, loosely to describe them as falling into one of three range-categories: local service, medium-haul, and long-haul. Each category of course overlaps the other, and some aircraft are as at-home in one regime as they are in another. But if the Vickers-Armstrongs Vanguard were to be described as a medium-hauler, this would—by 1956 standards—be misleading. It is easy to think of the Vanguard as a "bigger Viscount," overlooking the fact that it is an aircraft capable of seating 110 passengers, having a still-air range of more than 3,000 miles, and comparable in size with the Super-G Constellation and the DC-7C (it is in fact longer than both these aircraft).

The first point to be appreciated about the Vanguard, therefore, is its size. The second point is that, even though by present-day measures the aircraft is a long-hauler, it has been designed for highly economical operation on local-service sectors—by which are meant stages of down to 250 miles and less—an accomplishment which certainly no jet competitor can match.

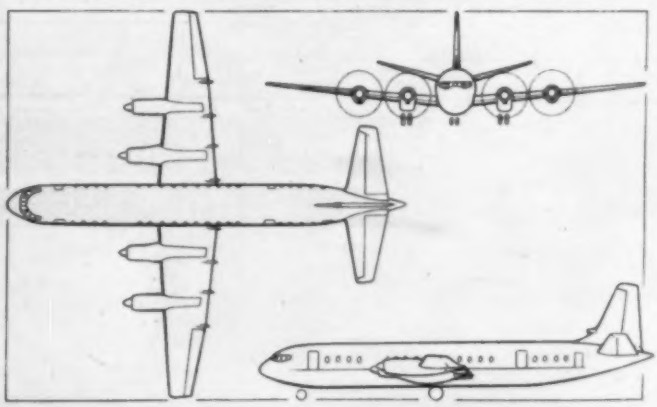
But the Vanguard's greatest commercial attribute—and one which it shares with no other airliner—is that, by virtue of its massive cargo holds, it can carry something like 85 per cent maximum payload with only a quarter of the passenger seats filled—and this is provided as an extra in an airliner with a normal seating capacity of 93 (at the same 39in seat-spacing as today's first-class Viscount), and with accommodation for up to 110 people at tourist-spacing.

Put another way, this means that the operator gets something for nothing—since the small increase in structure weight involved is indeed nothing when measured against the advantage of being able to fill the aeroplane up regardless of seasonal fluctuations in passenger traffic—the bane of every airline accountant.

We published in our issue of October 21 last a preliminary description of the Vanguard, tracing its early design evolution—in which British European Airways (who have ordered 20 with an option on five) played a big part. Now, seven months later, the mock-up is being completed (see next page), metal on the first aircraft is being cut (see page 676), and detail design is well advanced. The present article, therefore, does not retrace the ground already covered, but describes and illustrates the aircraft from the point of view of performance and design in as much detail as can be made available at the present time.

Structure. The Vanguard's airframe is of conventional all-metal construction, the wing being mounted in the mid-position of the double-bubble fuselage, whose upper section is devoted to passengers and the lower portion to freight space. The fuselage employs open frames supporting stringers to which the skin is flush-riveted. The two passenger entrance doors, fitted with inflatable seals and incorporating built-in folding airstairs, open outwards on the port side, there being emergency exit doors opposite each one on the starboard side.

The freight holds are loaded *via* large doors on the starboard



General arrangement of the Vanguard: leading particulars of the aircraft will be found on page 674.

The special feature of the Vanguard, well illustrated in this photograph of the mock-up, is the large volume of its two freight holds, totalling 1,430 cu ft in all. Floors are stressed to 150 lb/sq ft.

VICKERS VANGUARD . . .

side, and, like the main doors, are fitted with inflatable seals. Visual mechanical indicators as well as warning lights are provided to check locking of the freight doors. In addition to the emergency exit doors just mentioned, there are also two cabin windows per side (over the wing) designed to be used as emergency exits.

Access panels are flush-fitting with flush-type fasteners, and are sealed to prevent the entry of moisture. Particular care has been devoted to maintenance accessibility, and from this point of view the Vanguard, which has been engineered to inherit and improve upon the Viscount's excellent maintenance features, is certain to be second to none from the point of view of ease of servicing and overhaul. Vickers fully appreciate the need for ease of replacement in service of accessories and components; components and equipment have been designed to be quickly replaceable and generous access has been provided at points requiring regular servicing.

Powerplant. Rolls-Royce power, in the form of four RB.109 Tyne two-spool high-compression turboprops, was chosen for the Vanguard. Initially the Tyne will develop 4,470 e.h.p., but, as with the Dart of the Viscount, whose power has increased astonishingly in the course of development (from 1,000 e.h.p. in 1947 to the 2,000 e.h.p. of the latest versions), the Tyne's initial 4,470 e.h.p. is expected to rise similarly as experience is gained after entry into service in 1959. Current Vanguard performance estimates are, however, based on the initial 4,470 e.h.p. rating, although—significantly—Vickers are confidently anticipating already power increases of up to 5,500 e.h.p.

The Tyne, of which a description appeared in *Flight* for October 21, 1955, conforms to the classic two-spool arrangement whereby the high-pressure and low-pressure compressors are driven by separate turbines, the airscrew being coupled to the low pressure shaft through a compound epicyclic reduction gear.

No decision has yet been made as to which make of airscrew will be adopted: both Rotol and de Havilland have produced units with four solid light-alloy blades, and have had them running on Tyne test-beds at Derby. Production airscrews of both designs will be of 14ft 6in diameter.

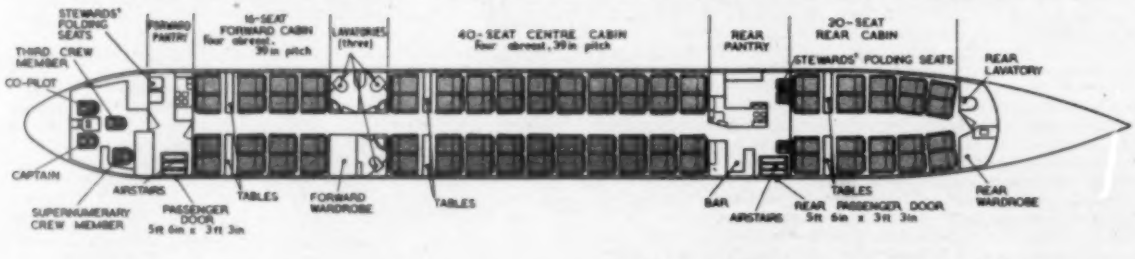
The engine is controlled by a single throttle-lever interconnected with the airscrew controller; automatic temperature control in the system maintains the correct power/airscrew speed relationship for take-off at different altitudes and temperatures, and to ensure maximum economy in changing air temperatures and forward speeds. The Vanguard's powerplant comprises the engine complete with nose cowling, an integral oil system, mounting, and fire-walls.

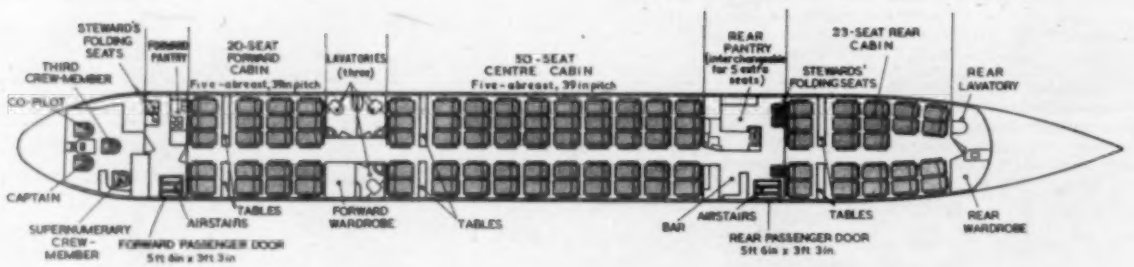
Accessory drives, together with electrical conduit and ducting, are mounted in nacelles forward of the wing structure. Cowlings, apart from the nose-cowling, are independently mounted and are of the petal-type for ease of access. All engines are interchangeable, and jet pipes can be removed without disturbing the installation. Accessory gearboxes are mounted under all engines: inboard nacelles each carry a cabin blower, a hydraulic pump and a de-icing alternator. The outboard nacelles also each carry a de-icing alternator and all engines have electric starters. A synchronization system is standard.

The larger size of the inboard nacelles of the Vanguard is of course accounted for by the undercarriage installation.

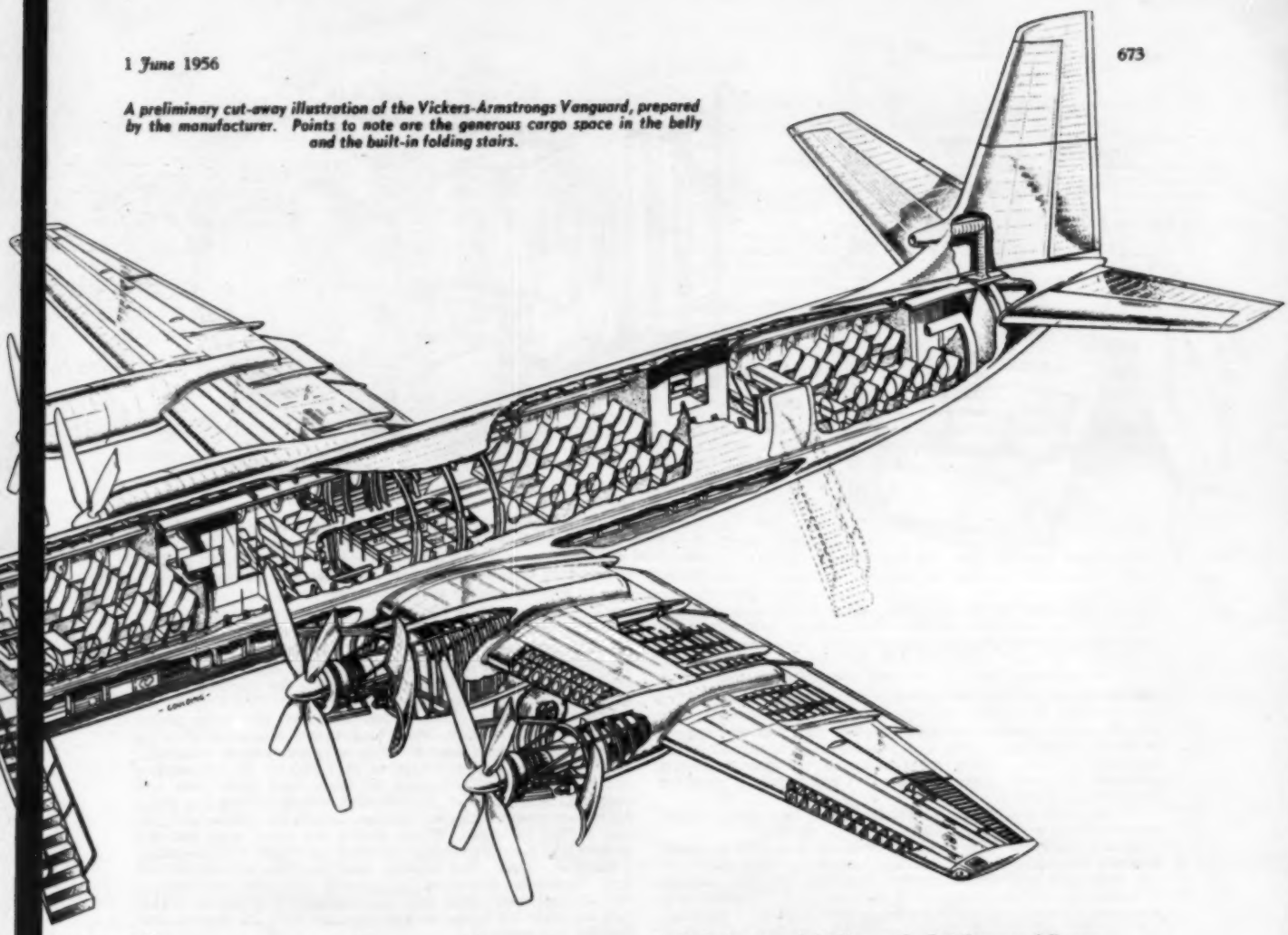
Payload Accommodation. Two typical layouts are illustrated in the diagrams shown below: a 76-seater and the standard 93-seat version. This latter layout is the one most likely to be adopted by British European Airways. A glance at the illustrations will show that each of these versions is identical in all respects, except that the extra accommodation in the 93-seater is provided by five-abreast instead of four-abreast chairs. Seat pitch, at 39in, is the same for each layout, and a good point is that each row of seats is opposite a window. By closing up the generous 39in seat pitch, dispensing with removable catering

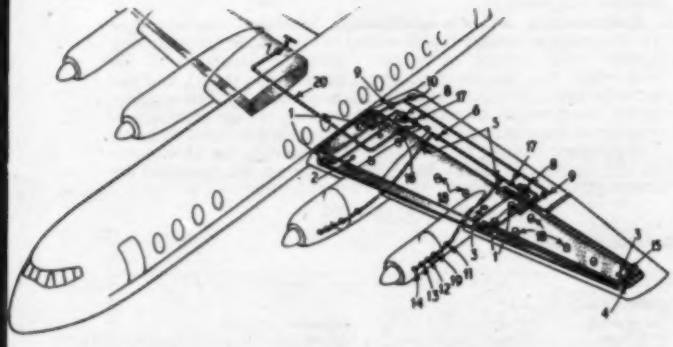
Two typical Vanguard cabin layouts. The upper diagram shows the 76-passenger version, with four-abreast seating at 39in pitch and the lower illustrates the standard B.E.A. 93-seat version, with five-abreast at 39in pitch. By removing catering accommodation, seating for 110 tourist passengers is available. The layout, with fore and aft entrances and pantries, lends itself well to mixed-class seating.





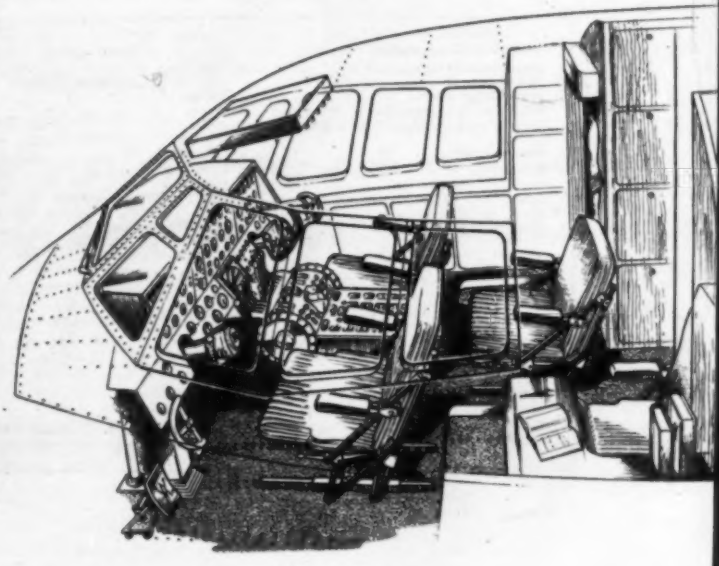
A preliminary cut-away illustration of the Vickers-Armstrongs Vanguard, prepared by the manufacturer. Points to note are the generous cargo space in the belly and the built-in folding stairs.





(Left) Fuel system of the Vanguard. Details are as follows:—
(1) fuel pump, (2) anti-surge valve, (3) filler cap, (4) float-operated vent valve, (5) engine master cock, (6) engine cross-feed cock, (7) aircraft cross-feed cock, (8) twin non-return valve, (9) refuelling/defuelling valve, (10) refuelling/defuelling connection, (11) flowmeter transmitter, (12) fuel heater, (13) fuel filter, (14) engine-driven fuel pump, (15) emergency pressure-relief valve, (16) sump and water drain, (17) low-pressure warning switch, (18) Pacitor tank unit, (19) backing pump, (20) cross-feed to starboard system.

(Below) The flight deck of the Vanguard has seating for a crew of three, although the aircraft can be operated by a captain and a co-pilot-engineer. A fourth seat is provided for a supernumerary.

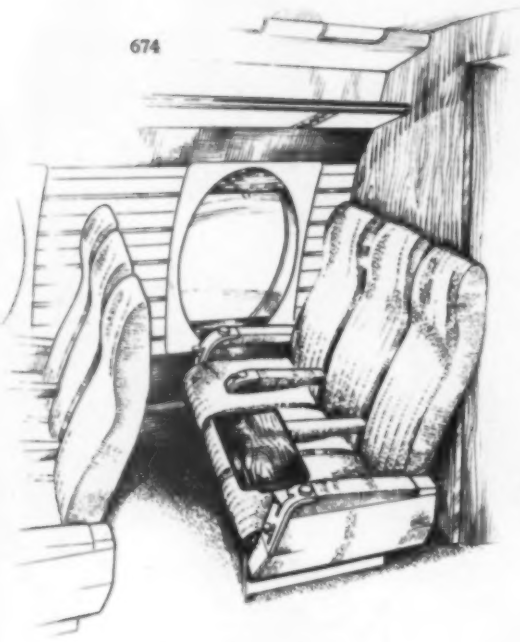


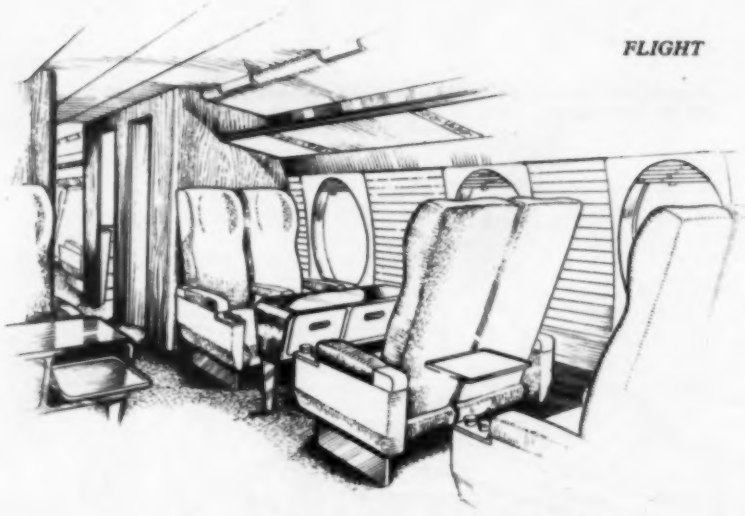
facilities, accommodation for 110 tourist passengers is available.

Seat-attachments are marked to indicate the position of seats for the various layouts, and allowance is made for the insertion of a movable bulkhead in the centre cabin to permit mixed-class accommodation. Indeed, the presence of both an entrance and a galley forward and aft lends itself admirably to the provision of mixed accommodation. Built-in air-stairs are fitted in at each entrance as standard. Lavatory accommodation amidships is situated in line with the airscrew discs.

The bottom hold of the Vanguard's double-bubble fuselage is devoted to two capacious freight compartments, 750 cu ft forward and 630 cu ft aft. The Vanguard's freight accommodation, as previously discussed, is an exceptional feature of the aircraft, permitting a high payload to be carried when only a few passenger seats are filled. The doors are large—5ft 6in wide, and, as shown in the picture, the holds are deep enough (4ft 3in) to enable a man to work inside with ease. The floors are stressed to 150 lb/sq ft.

Flight Deck. Entry to the Vanguard's flight deck is gained *via* the forward entry door. The layout conforms to S.A.E.





The most striking feature of the Vanguard's cabin will undoubtedly be the size of its windows, seen to advantage in these artist's impressions of (left) the triple chair, with one meal-tray in position, of the 93-seater, and (above) the spacious layout of the first-class 76-passenger version. The sketch on the right shows the forward pantry's generous stowage space.

VICKERS VANGUARD . . .

standards and provides for a crew of two with a seat for a third crew member to the rear and between the pilots' positions. The aircraft can be operated by two pilots; one pilot with an engineer in the co-pilot's seat, or by two pilots with a third man in the central seat who, having easy access to the central control pedestal, can act as flight engineer. A fourth seat is provided for a supernumerary.

All the basic controls are so arranged that they can be easily operated from any crew-position.

Flying Controls. The flying controls are manually operated, and are conventional in design and operation. Push-pull rods are employed, and where control runs pass through pressure structure torque tubes with rotary seals are used. Control locks are operated mechanically from the control pedestal; a mechanical restrictor bar permits power for taxying but not for take-off. The Fowler flaps are in four sections each side, of constant chord, and joined by a torque tube. Aft movement is provided by rollers in steel guide rails.

Fuel System. As shown in the illustration, fuel is carried in two integral tanks per wing, there being no fuel in the centre-section. Maximum capacity is 5,100 Imp. gal. The four-tank system is arranged so that each engine is fed from one tank during take-off and landing. Capacity-type gauges are fitted and dipsticks are provided. Each tank is fitted with two electric booster pumps, one being sufficient to maintain flow. Fuel cocks are electrically actuated, and a flow meter is fitted in each engine feed line. Pressure refuelling is provided, and refuelling for a 1,500 mile stage can be achieved in ten minutes. Over-wing filler caps are also provided.

Hydraulic System. The hydraulic system serves the under-carriage retraction, flaps, wheel brakes, and nose-wheel steering. Emergency undercarriage lowering is by mechanical "free-fall," and emergency flap operation is provided by an independent system. The built-in folding air-stairs have their own self-contained system, which is off-loaded during taxying and flight. All high-pressure hydraulic lines are outside the pressurized portion of the fuselage. Wheel brakes are fitted with anti-skid devices and are differentially operated by rudder-bar toe-pedals.

Landing Gear. The landing gear has twin wheels on each leg. Hydraulic retraction is forwards into the inner engine nacelles and nose-wheel bay, and mechanical downlock indicators are provided in the cockpit together with the conventional position indicators.

Pressurization and Air-conditioning System. The whole of the Vanguard's fuselage is pressurized to 6½ lb/sq in (representing 8,000ft cabin altitude at 30,000ft) with the exception of the nose-wheel bay, the nose (occupied by weather radar), and the extreme tail. Pressurization is accomplished by two engine-driven compressors on the inboard engines, either of which is capable of maintaining full pressure at maximum cabin altitude. Temperature control in the cabin is automatic, but is variable on the flight deck. Individual cold-air louvres are provided for passengers and crew.

TABLE I: LEADING PARTICULARS

Working Dimensions:	
Length overall	122ft 4in
Height overall	34ft 11in (ground line to fin top)
Track—oleo centres	30ft 0in
Height to sill of passenger entrance door	9ft 4in
Height to sill of freight loading door	4ft 8in
Main planes:	
Gross area	1,529 sq ft
Net area	1,347 sq ft
Span	118ft 7in (118ft projected)
Aspect ratio	9.10
Root chord	205in (15 per cent t/c)
Tip chord	77.8in (13 per cent t/c)
Aerofoil	N.A.C.A.63 (modified)
Dihedral	6 deg
Flaps (Fowler):	
Area per side	161 sq ft
Ailerons:	
Area aft of hinge-line	61 sq ft per side
Horizontal tail:	
Gross area	450 sq ft
Net area	382 sq ft
Elevator area	146 sq ft total
Vertical tail:	
Gross area	308 sq ft
Net area	220 sq ft
Rudder area	88 sq ft
Fuselage:	
Length	122ft 4in
Maximum width	11ft 6in
Maximum height	13ft 7.15in
Fuel capacity	5,100 Imp. gal. (6,125 U.S. gal.)
Forward cabin:	
Length	175.0in
Volume (gross)	1,000 cu ft
Centre cabin:	
Length	409.0in
Volume (gross)	2,346 cu ft
Rear cabin:	
Length	103.5in
Volume (gross)	591.5 cu ft

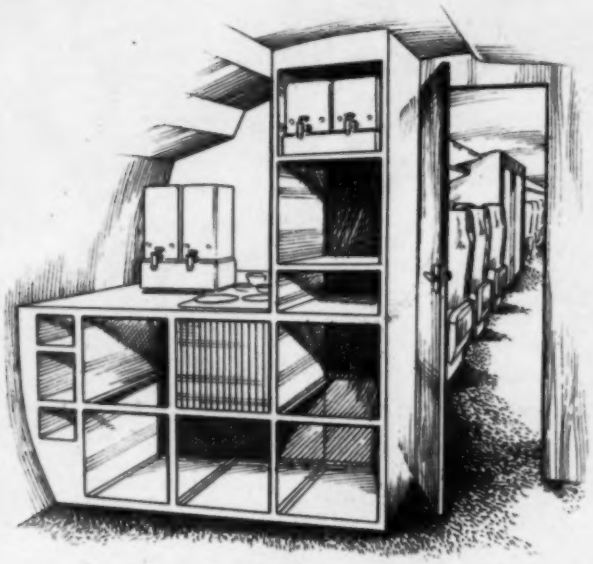


TABLE II: WEIGHTS AND PERFORMANCE

Weights:	
Maximum take-off weight	135,000 lb
Empty weight	71,200 lb
Typical empty operating weight, including three crew and baggage, four cabin crew, and removable catering	74,300 lb
Maximum payload (limited by zero fuel weight)	23,000 lb
Maximum zero fuel weight	98,500 lb
Design maximum payload (nominal)	21,000 lb
Maximum landing weight	108,500 lb
Performance (I.S.A. conditions):	
Take-off field length required to 50ft, sea level, at 135,000 lb	5,900ft
Rate of climb at 5,000ft and 135,000 lb	1,300ft/min
Cruising speed T.A.S. at maximum landing weight	400 m.p.h.*
Cruising altitude	25,000ft to 28,000ft
Landing distance from 50ft at sea level and maximum landing weight (approx.)	3,800ft

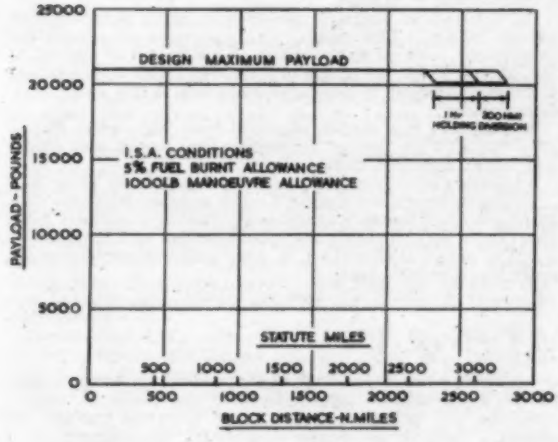
* This assumes maximum continuous power from the early Rolls-Royce Tyne. Cruising speed at normal operating power of the developed Tyne is expected to increase to 425 m.p.h. between 1959 and 1963.

Temperature control is accomplished by a primary cooler and by a refrigerator through which the charge air is routed, warming being accomplished by by-passing these units. Conditioned air is supplied at a rate of 150 lb per minute through a roof duct and exhausted through grills at foot level into the cabin. Cabin air is changed completely every two and a half minutes. Two discharge valves are fitted, one forward and the other aft; adjacent to the latter is installed the safety valve.

Provision is made for connecting the system on the ground to an air-conditioning truck (standard 8in connection). Recirculation fans are provided, one for the cabin, and a second for the flight deck. The fans can be run on the ground by using the ground electric supply.

De-icing System. De-icing of the main wings is thermal, by exhaust-heated fresh air. Engine air intake, airscrew and tailplane de-icing is electric.

Performance and Weights. The aircraft is designed for operation in climates ranging from tropical maximum conditions to temperate minimum, and complies fully with both British and United States airworthiness requirements. Current B.C.A.R.s undoubtedly represent the most up to date airworthiness code in existence, embodying 100 per cent temperature accountability.



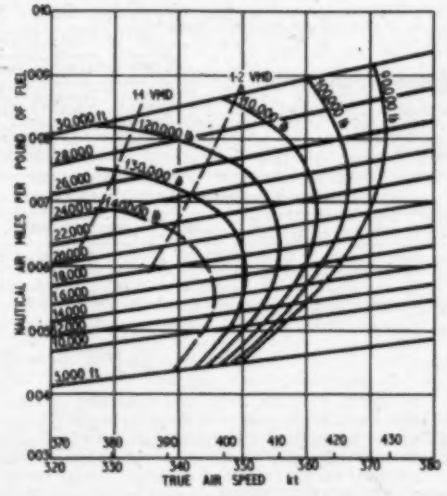


Fig. 1 (above, left). Commercial capabilities of the Vanguard—a plotting of payload against block distance. It shows that, with the fuel reserves stated, the aircraft can carry capacity payload for a stage length of 2,600 st. miles.

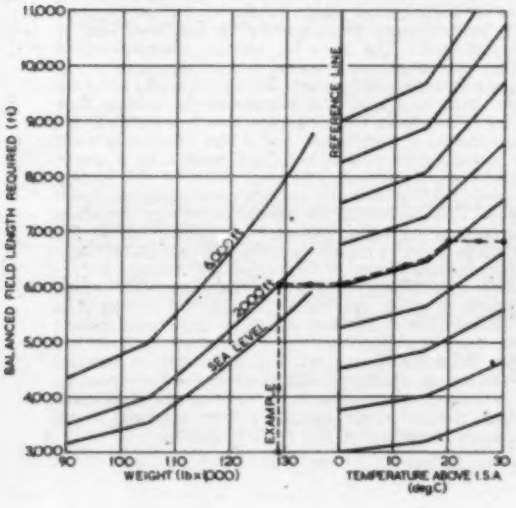


Fig. 2 (above, right). Estimated cruise performance, I.S.A., assuming "second development stage" of the Tyne (4,600 s.h.p. as against an initial 4,020 s.h.p.) and 13,500 r.p.m. Fig. 3 (left). Maximum take-off weight for take-off distance available and emergency distance available. As in Fig. 2, "development stage two" is assumed for the Tyne, plus water-methanol.

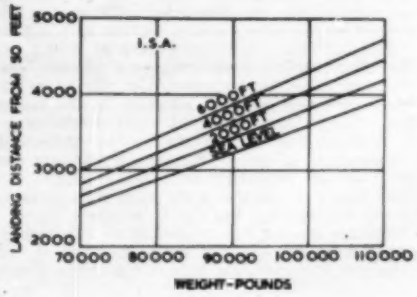
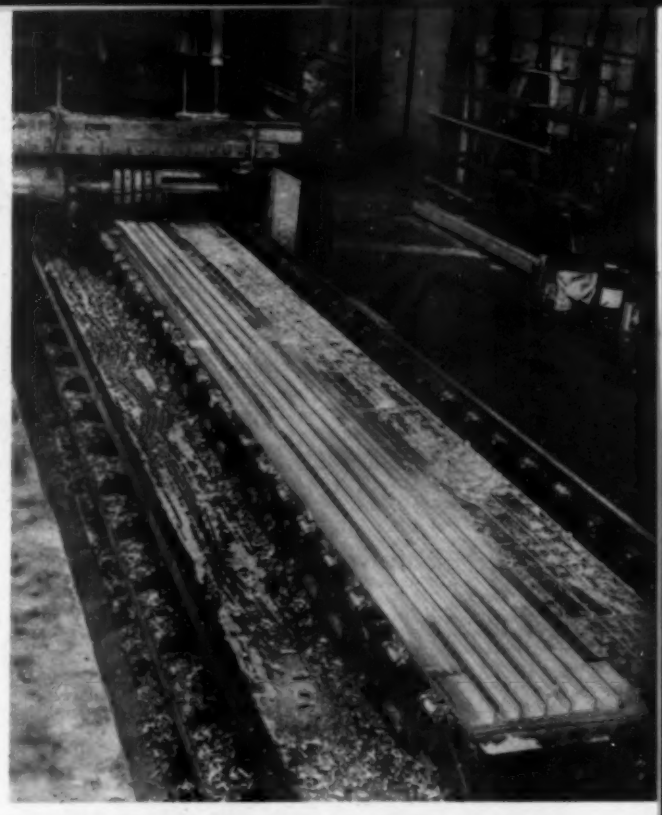


Fig. 4 (right). Landing distance from 50ft plotted against landing weight.



Perhaps the most clearly defined stage in the evolution of a new aircraft is the moment when first metal is cut. This picture records this stage in the Vanguard's development—milling of the aircraft's integrally stiffened wing-skin.

VICKERS VANGUARD . . .

An assessment of the Vanguard's payload-range performance may be gained from Fig. 1. This shows that the design maximum payload of 21,000 lb can be carried over a stage length of 2,600 st m with reserves for one hour's holding and a 230 st m diversion. Equivalent still-air range without these fuel allowances is 3,150 st miles. Included in both these range figures is a 5 per cent route allowance and a 1,000 lb manœuvre allowance.

Fig. 2 represents the Vanguard's cruising performance—true air speed (kt) plotted against nautical air miles per lb of fuel, for weights ranging from 90,000 lb to 140,000 lb and for altitudes of from 5,000ft to 30,000ft.

Fig. 3 shows the aircraft's take-off field length plotted against take-off weight. This graph, which provides adjustment for temperature, is based on the ability of the aircraft to take-off to 50ft, or stop within the length of the runway with engine failure at the critical point. It is in accordance with A.R.B. and C.A.A. requirements.

Fig. 4 shows true landing distances from 50ft; under British rules this is 70 per cent of the landing field length, and 60 per cent under American rules.

A summary of weights and performance is given in Table II.

To enable operators to make a quick assessment of the Vanguard over their routes, Vickers have published a specimen flight plan (Table III). This assumes a stage-length of 2,300 st miles in I.S.A. *en route* conditions, in zero wind and employing the optimum-range technique.

TABLE III: SPECIMEN FLIGHT PLAN

	lb
Typical operating weight empty	74,300
Design maximum payload	21,000
Reserve fuel	5,700
Landing weight	101,000
Block fuel	27,840
Manoeuvre allowance	1,000
Take-off weight	129,840

	Time (min)	Distance (n. m.)	Fuel (lb)
Climb to 23,500ft	35.5	130	3,000
Cruise at 23,500ft at 312 kt T.A.S. and 0.075 n.m./lb	100	525	7,000
Climb to 25,500ft	7	28	480
Cruise at 25,500ft at 314 kt T.A.S. and 0.0795 n.m./lb	106.5	556	7,000
Climb to 27,000ft	7	27	400
Cruise at 27,000ft at 321 kt T.A.S. and 0.085 n.m./lb	137	734	8,640
	393	2,000	26,520
Five per cent fuel tolerance	—	—	1,320
Block totals	393	2,000	27,840
Total block fuel			27,840 lb
Block time			6 hr 33 min

Cruise altitudes assumed in I.S.A. conditions

Stage-length, n.m.	500	1,000	1,500	2,000	2,500
Cruise altitude, ft	27,500	26,000 to 28,000	24,500 to 26,500	23,500 to 27,000	22,500 to 28,000

OPEN DAY AT N.P.L.

THE work of the National Physical Laboratory at Teddington has always been of the greatest interest to engineers in general, and this year's "open day," on Friday last, provided once more a most instructive glimpse of this work—a glimpse which more than compensated for the fatigue of walking through the grounds. The main problem of the visitor, as every year, was in deciding which exhibits to choose from the 223 available.

Among the aeronautical items, the development of high lift for landing and take-off provided a glimpse into the future of the jet flap. It may be recalled that in this scheme, originally developed at N.G.T.E., the efflux from a gas-turbine engine is ejected through a narrow slit extending along the wing trailing-edge or, as in the N.P.L. demonstration, along the knee of a small hinged flap. Without the hinged flap, the jet is inclined at an angle to the flight path, and not only provides lift and propulsive force by direct jet reaction, but also generates increased lift in a rather similar manner to a large trailing-edge flap.

The use of a small hinged flap to deflect the jet stream has the additional effect of retaining a smooth boundary-layer flow over the flap. As the velocity of the jet is increased, and the boundary layer becomes attached to the upper surface of the flap, the lift increases rapidly and thereafter a further increase is obtained—rather more slowly—by supercirculation. The demonstrations in one of the 9ft × 7ft tunnels showed the attachment of the boundary layer quite clearly. Experiments with boundary-layer control at the wing nose, combined with jet flaps at the trailing-edge, are also in progress.

Further interest was created by the experiments and theoretical programme investigating flow separation at high speed. In the 2.6in × 1.5in supersonic tunnel, fundamental aspects of the type of separation which is provoked by shock waves are being studied. Recent work includes investigations of the effects of surface curvature, and of heat transfer to and from the surface. At present a study of the factors determining the pressures on a blunt base in supersonic flow is also being made.

Interferometry is utilized in N.P.L. experiments investigating the influence of leading-edge shape on the change in the type of separation occurring as Mach number is increased and as incidence is changed. The 9in × 3in tunnel, incorporating a Mach-Zehnder interferometer, is being used for this purpose.

A high-speed extension of previous low-speed work, using oil and titanium oxide as a means of visualizing the surface flow on swept wings, has shown that the respective flow-patterns are similar. Experiments at high speed, and a film illustrating work in a water tunnel, showed that the "tip" vortex on a swept wing at high incidence originates at some point on the leading edge, this point moving inboard as incidence and sweepback are increased. This is caused by separation of the boundary layer at the nose of the wing, leading to a "rolling up" of the flow. This forms a vortex which extends outboard at an angle to the leading edge and thereafter forms the "tip" vortex.

Measurement of oscillatory forces on finite aspect-ratio wings with flaps has been made possible by equipment developed at N.P.L. At present this is installed in a 9.5in high-speed tunnel, and is being used in experiments on a half-delta wing with a full-span flap. With this apparatus it will be possible to measure directly all the forces relating to oscillation of the flap about its hinge, and to the pitching oscillation of the wing about different axes. A Mach number range extending from subsonic to 1.8 with a maximum frequency of 100 c.p.s. is possible.

THE DE HAVILLAND D.H.9A

HISTORIC MILITARY AIRCRAFT No. 13 PART II

By J. M. BRUCE, M.A.

IT is no disparagement of the D.H.9A to say that it was not the aeroplane it has so frequently been claimed to be: namely, the machine with which strategic bombing was initiated. That distinction was shared by several types of aircraft, and properly belongs to the machines which equipped the R.N.A.S. Third Wing during the winter of 1916-17. There can be little doubt that the D.H.9A would have proved an excellent instrument for the execution and development of strategic bombing attacks had the war lasted long enough for the aircraft to be used in large numbers.

A few D.H.9As were sent to coastal stations in the United Kingdom in the late summer of 1918. It was intended that, like the D.H.4s and D.H.9s before them, they should be used for over-sea patrols. They were not used for that purpose, however, because the valve gear of the Liberty engine was not considered to be sufficiently safe for over-sea flying. If that were the true reason it reflects an odd access of caution at a time when D.H.9s were being sent out over coastal waters, without such consideration for the waywardness of their Puma engines. At least one D.H.9A, E.9689, was fitted experimentally with a form of emergency flotation gear which had been designed by J. Samuel White and Co., Ltd., of East Cowes, Isle of Wight. The buoyancy element in this gear consisted of a large air-bag fitted under the forward position of the fuselage. When developed, the air-bag was deep and box-shaped, and a modified undercarriage had to be fitted. The vees were pivoted at the top of the rear legs, and the front legs could be unlocked to enable the entire undercarriage to be swung rearwards, out of the way of the developing air-bag. It is possible that the undercarriage could be raised before ditching.

Having been designed from the outset to have the Liberty engine, the D.H.9A found favour in American eyes, and it was adopted as the replacement for the D.H.4 in the United States Air Service. In the circumstances, it seems peculiar that the design was so extensively modified by American engineers. It was, of course, renamed: its American designation was USD-9A.

In construction the USD-9A resembled the D.H.9A. The longerons were of 1¼in-sq ash, and the *patons* were of spruce. The forward portion of the fuselage was covered with 3/32in plywood which consisted of a poplar core with vertical grain sandwiched between two outer plies of mahogany with grain running longitudinally. The aerofoil section of the mainplanes was an American development of R.A.F.15, slightly deeper at the spars and with reduced undercamber. The spars were of solid spruce, spindled out between the compression struts, of which there were five in each wing panel. Ribs were made of 5/32in plywood; a poplar core 3/32in thick had its grain running longitudinally, and lay between 1/32in plies of birch with grain vertical.

Figures quoted in a contemporary American description of the USD-9A indicate that the gap was 7½in greater than that of the D.H.9A, and that stagger was reduced to 12½in. The same report quotes areas for ailerons and all tail surfaces which do not tally with the corresponding values for the British aircraft. Although this is not an infallible indication that the surfaces in question had been re-designed, it is certain that production USD-9As were to have had a rudder of more rounded appearance than the characteristic D.H. rudder. At least one of the prototypes had the modified rudder.

The USD-9A was fitted with a special fuel system which had been developed at McCook Field. As on the D.H.9A, the main tank was fitted immediately behind the engine. It had a capacity of 134 U.S. gallons, and petrol was passed to the carburettors by two Vane force pumps which were driven from the engine crankshaft by a flexible drive. A gravity tank of 9 U.S. gallons capacity was mounted in the centre section.

Dual control was fitted to the USD-9A, and differed in detail from the control arrangements of the D.H.9A. The pilot's armament consisted of a fixed Browning machine-gun with 750 rounds of ammunition; the gun was mounted on the starboard side of the fuselage, whereas the Vickers gun of the D.H.9A was on the port side. The USD-9A's observer had a pair of Lewis guns on a Scarff ring-mounting; ten 97-round drums were carried.

It was intended to use the USD-9A either as a bomber or as a reconnaissance aircraft. The maximum load of the bomber version consisted of six 50-lb bombs carried in racks under the wings and two 110-lb bombs under the fuselage.

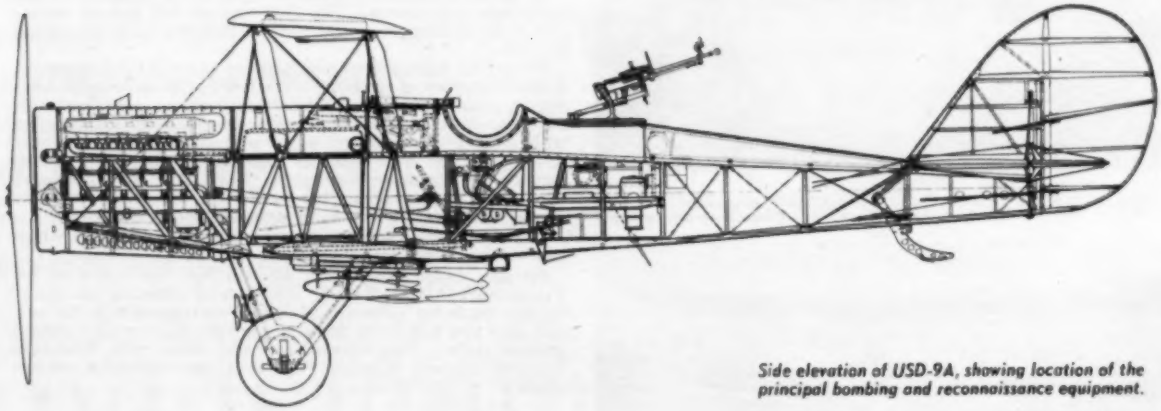
Nine prototypes were built, four by the Dayton-Wright Aeroplane Co., and five by the Engineering Division of the Bureau of Aircraft Production. The first Dayton-Wright USD-9A was delivered in October 1918, followed next month by the first machine built by the Engineering Division. A contract for 4,000 USD-9As was given to the Curtiss company but was cancelled when the Armistice was signed. No production machines were delivered. In February 1919 the Engineering Division fitted one of its USD-9As with wings of increased area and installed a Liberty 12-A engine. This modified machine was re-designated USD-9B.

After the war the D.H.9A remained in service with the Royal Air Force for many years, and was outlived only by the immortal Bristol Fighter. The type formed part of the equipment of squadrons Nos. 47 and 221, which operated against the Bolsheviks in Russia in 1919-20. No. 221 Sqn. arrived at its aerodrome at Petrovsk in the middle of January 1919, and had most of its aircraft assembled by the 28th of that month. The machines had to be erected in the open in sub-zero temperatures. The D.H.9As of No. 221 did not make an auspicious start to their Russian operations. On February 10, 1919, two of them bombed a cavalry unit south of Astrakhan; each machine carried one 230-lb and two 65-lb bombs, and a considerable number of casualties were caused. Unfortunately, the cavalry were a White Russian squadron.

None of the British aircraft which participated in the Russian campaign distinguished themselves. Flying was possible in the summer of 1919, but disease took a heavy toll of the personnel of the two squadrons. On June 22, 1919, six additional D.H.9As were delivered to No. 221 Sqn.

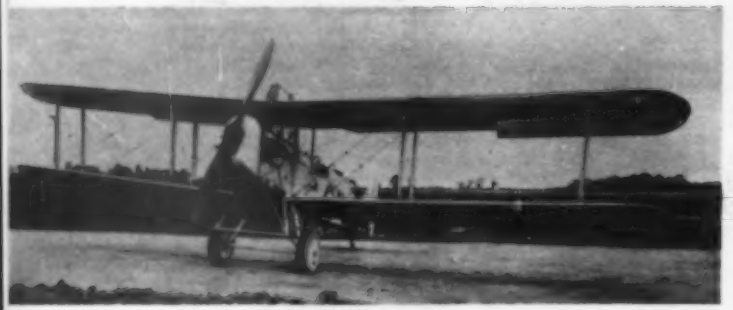
By Christmas 1919 the winter weather again limited operations, and at that time No. 47 Squadron's only serviceable aircraft was a single D.H.9A. By then the White Russian forces were under pressure from the Bolsheviks, and the R.A.F. unit was steadily withdrawn. Its aircraft suffered various mishaps, and there can be no doubt that some of the D.H.9As fell into the hands of the Bolsheviks.

The qualities of the aircraft must have made a favourable impression on the Reds, for the type was built in post-revolutionary Russia—doubtless without the formality of a licence. The



Side elevation of USD-9A, showing location of the principal bombing and reconnaissance equipment.

D.H.9A with tropical radiator.



This D.H.9A had a Napier Lion engine and an oleo undercarriage.

THE DE HAVILLAND D.H.9A . . .

Russian-built machines were designated R-1; the initial letter signified *Razv'edchik*, or reconnaissance aircraft. The first few R-1s are believed to have been powered by captured Liberty engines, but the power unit was also copied and built in Russia as the M-5 engine.

During the 1920s the D.H.9A was widely used at home and overseas. It shared with the Bristol Fighter the task of policing Iraq, a thankless and unspectacular job which the two war veterans performed efficiently. Control of the British forces in Iraq passed to the Royal Air Force on October 1, 1922, when Air Vice-Marshal Sir John Salmond, K.C.B., C.M.G., C.V.O., D.S.O., assumed command. The D.H.9A squadrons which served in Iraq were Nos. 8, 30, 55 and 84, and their aircraft played a leading part in subduing the unruly tribes which were seldom at peace, either with one another or the administration.

In the summer of 1923 the fiery Sheikh Mahmud proclaimed himself King of Kurdistan, began a series of raids from his capital of Sulaimaniya, and finally, encouraged by the rebellion of a number of sheikhs in southern Iraq and Nejd, declared a Jihad against England and her Assyrian allies. Action against Mahmud began with a bombing attack on Sulaimaniya, made by forty-two aircraft which included some D.H.9As from Nos. 8 and 30 Sqns.; and the Sheikh finally submitted in 1927, for a time at least.

The D.H.9A also served in India with Nos. 27 and 60 Sqns., and in Egypt with No. 47 Sqn.; additionally, operational flights in Trans-Jordan and Aden were equipped with the type. In the East the Nine Ack—as the D.H.9A was often called—acquired additional equipment in the best Christmas-tree tradition. A tropical radiator was installed under the engine, and a spare landing wheel was bolted to the fuselage, either under the gunner's cockpit or on the starboard side just behind the engine. Spare parts, emergency rations and water were carried, the last-named frequently contained in animal skins slung from the gun-ring to hang outside the fuselage in the comparative coolness of the slip-stream. Compared with these primitive attachments, the bomb racks, flare brackets and long-range petrol tanks were relatively minor excrescences. Many D.H.9As had a single long-range tank attached to the underside of the starboard upper mainplane, but some machines had one under each upper wing. The various attachments must have had a disastrous effect on performance.

Some D.H.9As assisted in the evacuation of Kabul in December, 1928. The city was besieged by the rebel Kabibullah Khan. Sir Francis Humphrys, the British Envoy Extraordinary, radioed a message that he desired the evacuation of the women and children of the British Legation as soon as possible. The message ended abruptly, and communication was severed. Several gallant flights were made by D.H.9As to drop messages and signalling equipment for the Legation.

Inevitably, a number of modifications had been made to the D.H.9A during its long service. During 1923 it was found that the joints in the mainplane spars just inboard of the ailerons had a tendency to open up. At the end of the year all aircraft were examined for this defect, and the jointed spars were replaced by one-piece members.

Earlier in 1923, split-axle undercarriages were introduced. These were generally similar to the kind of undercarriage favoured by the wartime Sopwith company: each wheel was attached to a half-axle which was hinged at its inboard end, and springing was still by rubber shock-cord. Additional bracing wires ran from the fuselage to the inner ends of the half-axles. In the spring of 1925, oleo undercarriages were issued for the D.H.9As in use at flying training schools and the R.A.F. College, Cranwell. The use of this form of undercarriage was discontinued in 1927, however, and the split-axle landing-gear remained standard.

In 1924, some of the D.H.9As of No. 207 Sqn. were fitted with R.A.E. silencers (which were possibly the outcome of the experiments which had been conducted at Farnborough with such aircraft as the S.E.5a, D.203, and the Nieuport Nighthawk, J.2415). There may have been some connection between this modification of the D.H.9As and the roughly contemporary installation of early radio-telephony equipment in the squadron's aircraft, but the silencers did not prove particularly effective as had been expected.

The D.H.9A was used in some numbers at flying training schools and other training units, and No. 24 Sqn. had seven for communications duties. After its withdrawal from front-line squadrons the Ninak remained in service with several squadrons of the Royal Auxiliary Air Force.

In the Commonwealth, a few examples of the type saw service in Canada and Australia. In 1924 Canada had nine in service and seven in storage; and Australia's D.H.9As were still in use in 1928.

During the 1920s several modifications of the D.H.9A appeared. A small number of machines were fitted with the Napier Lion engine; a blunt cowling and underslung radiator were fitted. Of the Lion-powered machines, E.752 was used in deck-landing trials which were carried out on the aircraft carrier H.M.S. *Eagle*. A few D.H.9As were specially modified for use from aircraft carriers. To facilitate stowage on board ship, the mainplanes were made quickly detachable by the use of special wing-root fittings and a locking device. Slinging gear was fitted.

The Lion engine was also installed in J.6957, a D.H.9A which had an oleo undercarriage.

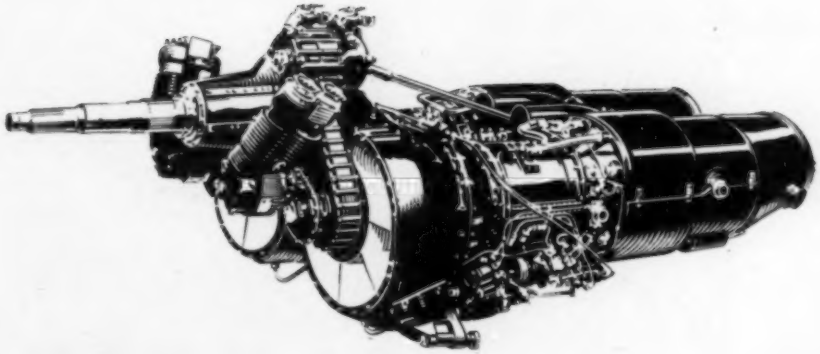
An oleo undercarriage of a different type was tested on the Vulcan-built D.H.9A, E.9895. This was an unusually tall undercarriage made by Vickers, Ltd., and a correspondingly tall tail-skid structure had to be fitted to preserve the aircraft's normal ground angle. This aircraft was also fitted with Frise-type balanced ailerons, Handley Page slots, and enormous exhaust pipes.

Vickers oleo undercarriage, Handley Page slots and Frise ailerons.

(Below) D.H.9A with air-cooled Liberty and Fairey-Reed airscrew.
(Crown copyright reserved)

Proof before prophecy

It is not our business to debate the future, but to build it. Progress in the air is won, we believe, by ruthless concentration on the present task. Our first duty is to create aircraft engines which fulfil required functions under all conceivable conditions—engines such as the compact Double Mamba turbo-prop, now successfully serving the special needs of the anti-submarine Fairey Gannet in squadron service with the Royal Navy. Our responsibility then lies, as we see it, in the searching and systematic development of these proven types, in order that they may match the evolution of aircraft design with progressive yet predictable performance.

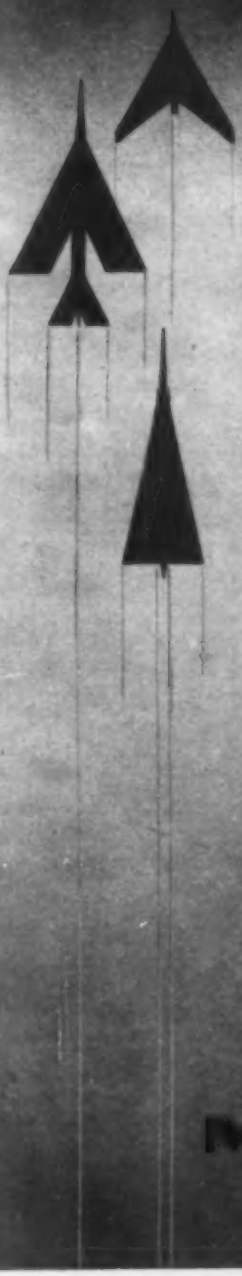


ARMSTRONG SIDDELEY AERO ENGINES

ARMSTRONG SIDDELEY, COVENTRY & BROCKWORTH

Members of the Hawker Siddeley Group

pioneer designers of the ejection seat



UNPARALLELED ACHIEVEMENTS

Squadron Leader J. F. Fifield, D.F.C., A.F.C., made aviation history when he successfully ejected from a Meteor aircraft at runway level during September and again the following month at an altitude of more than 40,000 feet.

Martin-Baker Fully Automatic Ejection Seats were used for both tests, proving yet again that these seats are undoubtedly the finest in the world of aviation.

NOTE TO AIRCREW:

The seat used for the runway ejection was fitted with modified time release, not yet incorporated in Service equipment.

MARTIN-BAKER

THE DE HAVILLAND D.H.9A . . .

Another interesting but little-known experimental D.H.9A was H.3588, which was fitted with a special air-cooled version of the Liberty driving a Fairey-Reed metal airscrew. As the illustration (p. 678) shows, the installation was an unprepossessing affair, characterized by an ugly intake, uglier outlets, and long exhaust pipes. The official photograph of the aircraft is dated April 27, 1933.

Several developments of the D.H.9A design were built. The first of these appeared in 1919, with the designation D.H.15 and the official name Gazelle. This was virtually a D.H.9A airframe modified to accommodate the Galloway Atlantic engine, a vee-twelve which was rated at 500 h.p. It will be recalled (see *Flight*, April 6, 1956, page 386) that the Galloway company had made a version of the 230 h.p. B.H.P. engine with a cast-iron cylinder block. The Atlantic was, in effect, two such engines united on a common crankcase.

The first Atlantic engine appeared in 1918 and was put into production; by October 31, 1918, twenty-five engines of this type had been delivered. However, the engine underwent a process of modification analogous to that which had transformed the 230 h.p. B.H.P. (Galloway Adriatic) into the mass-produced Siddeley Puma. The transformation produced a double Puma, with aluminium cylinder blocks, which was named Siddeley Pacific. Either the difficulties which had beset the Puma and its production had been overcome, or the authorities of the day were incapable of learning from their mistakes, for the Pacific was ordered into production on a large scale.

It is not known whether it was intended to install the Pacific in the D.H.15, but it seems most probable that the aircraft was built solely as an insurance against the possible failure of the more advanced D.H.14, or Airco Okapi, a massive biplane designed as a D.H.9A replacement and powered by the then-new and untried 600 h.p. Rolls-Royce Condor engine. The Armistice prevented the development of the D.H.14 by eliminating the need for it, and the D.H.15 was also abandoned.

In appearance the D.H.15 resembled the D.H.9A closely, for the engine installation differed little externally from that of the Liberty. The radiator was slightly different in shape, and the Atlantic engine was fitted with long exhaust pipes which terminated beside the gunner's cockpit.

A development of rather a different kind originated in 1920 as an official design for a three-seat deck-landing naval reconnaissance aircraft based on the D.H.9A. Doubtless it was hoped to effect a substantial economy by giving carrier-borne units a modified version of the R.A.F.'s standard day bomber, but, as with so many adaptations of a like nature, it was not an unqualified success. The design envisaged the location of the pilot and gunner in the normal positions, and a third cockpit was provided behind the gunner's. This rearmost seat was occupied by the observer, who also had a partially-glazed ventral trough position built on below the fuselage.

The prototype aircraft was J.6585, which was apparently built by the Armstrong Whitworth company and bore the name "Tadpole" on its nose. This machine had the Liberty engine and retained a marked resemblance to the D.H.9A. The wings, tail unit, undercarriage, and basic fuselage structure of the Nine Ack were employed, but the incorporation of the third cockpit altered the appearance of the rear fuselage: the ventral "bath" was immediately conspicuous, and the top decking was modified in an ugly fashion to give depth to a cockpit which was situated at a point where the basic fuselage was relatively shallow. The entire fuselage of the Tadpole was covered with plywood, and the stagger was considerably reduced.

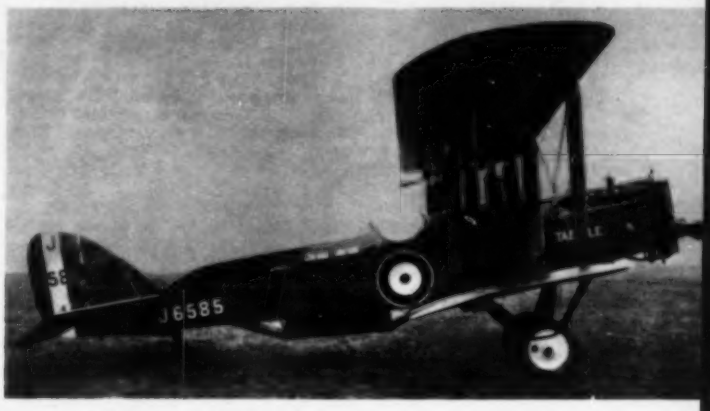
Development of the design was entrusted to the Westland Aircraft Works, and the aircraft was named Walrus. The ultimate product was one of the most unprepossessing aeroplanes which ever took the air. There can be little doubt that the aircraft was somewhat under-powered with the Liberty engine. The 450 h.p. Napier Lion II was substituted but its additional power can hardly have been sufficient to cope with the many drag-producing modifications which were made to the Walrus. The Lion-powered production version had a modified, jettisonable undercarriage fitted with a hydrovane, and jaws for the fore-and-aft arrester wires of the period were mounted on the underside of the spreader bars; emergency flotation bags, carried externally and inflated by compressed air, were fitted; and wing-folding was incorporated. A special valve on the main fuel tank permitted the rapid jettisoning of the fuel and re-sealing of the tank, which then became an additional flotation chamber.

The test flying of the Walrus was performed by Capt. A. S. Keep, M.C. The aircraft was reported to be unpleasant to fly, but a batch of 36 were nevertheless ordered. One of these was later fitted with high-lift wings, horn-balanced ailerons and elevators, and an oleo undercarriage. By that time the Walrus had lost all resemblance to the handsome D.H.9A from which it was descended.

It will be recalled that the first aeroplane to fly with Handley Page slots was a D.H.9. That was in 1920, and in the following year there appeared the Handley Page X.4B, which later acquired the type number H.P.20. This remarkable aircraft consisted of the fuselage of a standard D.H.9A, H.634, to which a slotted cantilever monoplane wing was fitted. The X.4B was a single-seater, and was flown from what would have been the rear cockpit in a standard D.H.9A fuselage. A tall undercarriage was fitted, and the aircraft weighed 6,500 lb loaded, a figure which gives some idea of the structure weight of that early cantilever wing, for the standard D.H.9A weighed only 4,645 lb with two 230-lb bombs and fuel for 5¼ hours.

The ultimate D.H.9A development appeared in 1926. Known as the D.H.9AJ, or Stag, this machine was built by the

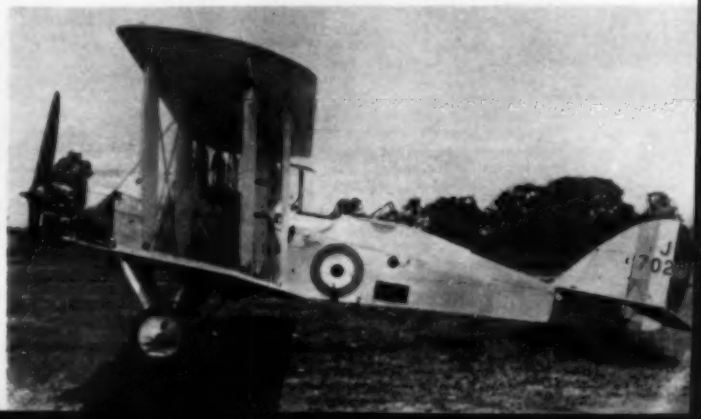
D.H.15 Gazelle.



Armstrong Whitworth Tadpole (Walrus prototype).

Westland Walrus.

D.H.9AJ Stag.



Civil-registered D.H.9A, with Rolls-Royce Eagle VIII.

THE DE HAVILLAND D.H.9A . . .

de Havilland Aircraft Co., and was powered by a 465 h.p. Bristol Jupiter VI engine. Differential ailerons and a neat oleo undercarriage were fitted. The Stag, which was numbered J.7028, first flew on June 15, 1926.

It was perhaps fitting that the replacement for the D.H.9A was provided by the Westland Aircraft Company. Such was the official pre-occupation with economy that the Air Ministry specification required the replacement type to incorporate as many standard D.H.9A parts as possible. The Westland design, named Wapiti, first flew early in 1927. It originally embodied D.H.9A mainplanes and tail unit, and was ultimately selected for production. The Wapiti's deep fuselage made the D.H.9A fin and rudder too small, however, and they had to be replaced by larger surfaces. As production Wapitis became available they replaced the faithful old D.H.9As, which ended their service in the Auxiliary squadrons.

Unlike the D.H.9, the D.H.9A did not go into civilian use in large numbers. Very few received British civil registrations. One machine, G-EBCG, the property of the Aircraft Disposal Co., had a Rolls-Royce VIII engine, and was flown in some of the air races in the early post-war years.

The D.H.9A was therefore essentially a military aeroplane, and is assured of its niche in the history of the R.A.F.—the fame of the Nine Ack is secure, both as a potentially great aircraft of the First World War and as a patient, hard-working jack-of-all-trades on a more or less constant operational footing during the decade which followed the Armistice.

SPECIFICATIONS AND SUMMARY

Powerplant.—*D.H.9A*: 375 h.p. Rolls-Royce Eagle VIII, 400 h.p. Liberty 12, 450 h.p. Napier Lion, 400 h.p. M-5 (Russian copy of the Liberty). *USD-9A*: 400 h.p. Liberty 12. *USD-9B*: 400 h.p. Liberty 12-A. *D.H.15*: 500 h.p. B.H.P. (Galloway) Atlantic. *Stag*: 465 h.p. Bristol Jupiter VI.

Dimensions.—*D.H.9A*: Span, 45ft. 11¾in; length, 30ft 3in; height, 11ft 4in; chord, 5ft 9in; gap, 5ft 6in; stagger, 16in; dihedral, 3 deg; incidence, 3 deg; span of tail, 13ft 10in; airscrew diameter (Liberty), 10ft. *USD-9A*: Span, 45ft 11in; length, 30ft 2⅝in; height, 10ft 6in; chord, 5ft 9in; gap, 6ft 1½in; stagger, 12½in; dihedral, 3 deg; airscrew diameter, 9ft 10in.

Areas.—*D.H.9A*: Wings, 486.73 sq ft; ailerons (total), 74.36 sq ft; tailplane, 38 sq ft; elevators, 24 sq ft; fin, 5.4 sq ft; rudder, 13.7 sq ft. *USD-9A*: Wings, 490 sq ft; ailerons (total), 72.28 sq ft; tailplane, 39.06 sq ft; elevators, 23.64 sq ft; fin, 5.21 sq ft; rudder, 13.53 sq ft.

Manufacturers.—The Aircraft Manufacturing Co., Ltd., Hendon, London, N.W.

Other Contractors.—F. W. Berwick and Co., Ltd., Park Royal, London, N.W.; Mann, Egerton and Co., Ltd., Aircraft Works, Norwich; Vulcan Motor and Engineering Co. (1906), Ltd., Crossens, Southport; Westland Aircraft Works, Yeovil, Somerset.

Production and Allocation.—A total of 885 D.H.9As had passed final inspection by the end of 1918. Deliveries to R.A.F. squadrons totalled 272 by October 31, 1918; of these, 70 went to squadrons with the B.E.F., 89 to the Independent Force, and 113 to training units. The R.A.F. had 405 D.H.9As on charge on October 31: 66 with the B.E.F., 83 with the Independent Force, 12 at coastal stations, 50 at training units, 105 with contractors, 25 with squadrons mobilizing, 2 at Aeroplane Repair Depots, 24 in store, and 38 at various stations in the United Kingdom.

Costs.—Airframe without engine, instruments or armament, £1,599 12s; engines: Liberty 12, £1,215; Rolls-Royce Eagle VIII, £1,622 10s.

Armament.—One fixed Vickers machine-gun mounted outside the fuselage on the port side just in front of the pilot's cockpit; this gun was synchronized to fire forward through the airscrew by means of Constantinesco C.C. gear. The observer had a single Lewis gun or a double-yoked pair on a Scarff ring-mounting. Up to 660 lb of bombs could be carried on external racks under the fuselage and lower mainplanes. The normal load consisted of two 230-lb bombs, but fourteen 20-pounders could be carried additionally.

The USD-9A had a fixed Browning machine-gun, mounted on the starboard side, for the pilot; 750 rounds of ammunition were carried. The observer had twin Lewis guns, for which ten 97-round drums were provided. The bomb load consisted of two 110-lb bombs under the fuselage and six 50-pounders under the lower wings.

Service Use (Wartime).—*Western Front:* R.A.F. squadrons Nos. 18, 99, 110 and 205. *Russia:* R.A.F. squadrons Nos. 47 and 221. *Coastal Units:* R.A.F. squadrons Nos. 212 and 273. *Training:* Used at various aerodromes, including Cranwell, Fowlmere and Waddington.

Service Use (Post War).—*Home Stations:* No. 14 Sqn; Nos. 39 and 100 Sqns., Spittlegate, 18 aircraft each; No. 207 Sqn., Bircham Newton, 18; No. 24 Sqn., seven (for communications duties); No. 1 F.T.S., Netheravon, nine; No. 2 F.T.S., Duxford, 15; No. 5 F.T.S., Shotwick, nine; No. 6 F.T.S., Manston, 20; No. 7 F.T.S., Spittlegate, 20; Aerial Gunnery School, Eastchurch, six; School of Technical Training, Halton, two; Leuchars Station Flight, three; R.A.F. College, Cranwell, six; R.A.F. Station Hawkinge, 25 aircraft in reserve. Royal Auxiliary Air Force Sqns. Nos. 600, 601, 602, 603 and 605. *Egypt:* No. 47 Sqn.; No. 4 F.T.S., Abu Sueir. *India:* Sqns. Nos. 27 and 60. *Iraq:* Sqns. Nos. 8, 30, 55 and 84. Also used by Operation Flights in Trans-Jordan (three aircraft) and Aden (eight).

WEIGHTS AND PERFORMANCE

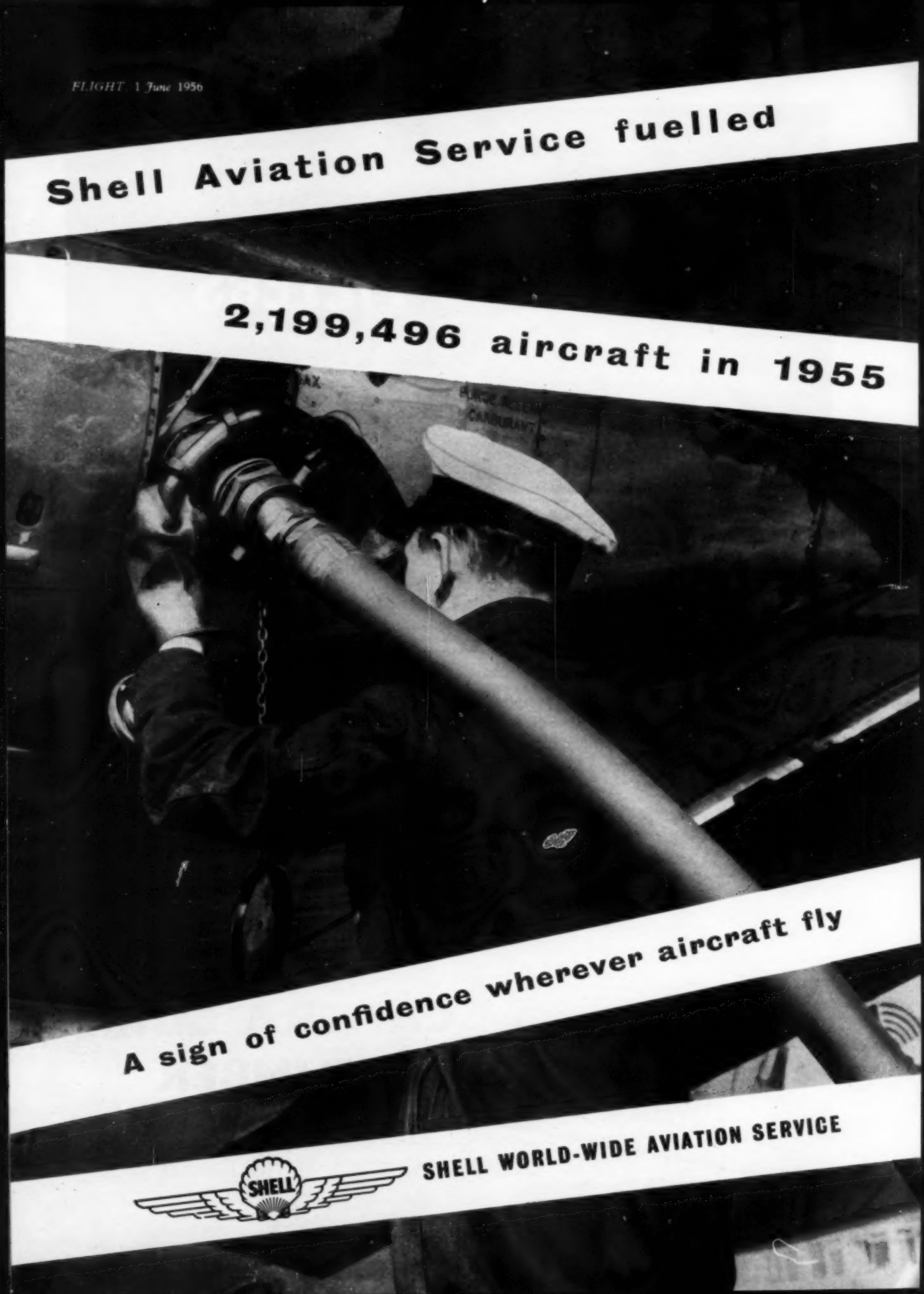
Aircraft	D.H.9A with 2 x 230-lb bombs		D.H.9A	USD-9A		D.H.15	Stag
				Reconnaissance version	Bomber version		
Engine	Eagle	Liberty	Lion	Liberty		Atlantic	Jupiter VI
Weight empty (lb)	2,705	2,800	2,557	—	—	—	—
Military load (lb)	968	940	—	—	—	—	—
Fuel and oil (lb)	550	905	—	—	—	—	—
Weight loaded (lb)	4,223	4,645	4,660	4,521	4,987	4,773	4,800
Maximum speed (m.p.h.) at:							
Sea level	—	123	—	126	121	139	126
10,000ft	118	114.5	124	118	114	133	116
15,000ft	104.5	106	125.5	107	85	—	—
Climb (min and sec) to:							
6,500ft	8 40	8 55	—	9 15	12 00	4 55*	—
10,000ft	15 35	15 45	10 30	16 40	22 00	8 12	—
15,000ft	33 40	33 00	—	—	—	—	—
Service ceiling (ft)	16,000	16,750	21,300	17,000	14,300	20,000	—
Endurance (hr)	—	5½	—	—	—	—	—

* At 4,230 lb a.u.w.

Serial Numbers.—B.7664 built by Westland, with Eagle engine; C.6122 built by Westland, with Liberty; C.6350 by Aircraft Manufacturing Co., with Eagle; E.701-E.1000 and E.8407-E.8806 by Aircraft Manufacturing Co.; E.9657-E.9756 by Mann, Egerton; E.9857-E.9956, Vulcan Motor and Engineering; F.951-F.1100, Westland; F.1603-F.1652, Westland; between and about F.2816-F.2869 (part of a batch which may have been F.2733-F.2902, possibly the 170 D.H.9As ordered from F. W. Berwick); F.3842; F.9922; H.1-H.150 and possibly beyond; between and about H.3430-H.3650, of which H.3486 is known to have been Westland-built; H.4243, Westland-built; between and about J.554-J.568, of which J.568 is believed to have been built by Mann, Egerton; J.6957-J.6959; J.7008, J.7009, J.7024, J.7028, J.7030, J.7034, J.7035, J.7038, J.7039, J.7041, J.7047, J.7048, J.7058, J.7059, J.7062-J.7089; J.7094, J.7107, J.7109, J.7116, J.7117, J.7122, J.7124, J.7256-J.7258; J.7302-J.7309; J.7316, J.7329, J.7331-J.7333; J.7337, J.7340, J.7342, J.7356, J.7605-J.7607; J.7614, J.7615, J.7787-J.7798; J.7809, J.7814, J.7818, J.7831, J.7832, J.7835, J.7842, J.7850, J.7854, J.7877-J.7883; J.7888, J.7890, J.8098-J.8223; J.8292-J.8294; J.8462, J.8470, J.8472, J.8473, J.8478, J.8489, J.8492.

Notes on Individual Machines.—*Used by No. 14 Sqn.:* H.3570, J.7035, J.7067, J.7116, J.7831, J.8098, J.8101, J.8197, J.8203. *Used by No. 27 Sqn.:* E.8673 (Aircraft "B"), H.23 ("A"). *Used by No. 39 Sqn.:* E.876 (Aircraft "4"), E.948 ("1"), H.3552, J.7058 ("12"), J.7062, J.7067, J.7073 ("8"), J.7089, J.7818 ("2"), J.8144 ("1"), J.8152, J.8173. *Used by No. 47 Sqn.:* J.7086, J.7094, J.7331. *Used by No. 60 Sqn.:* E.785 ("Q"), E.878 ("I"), E.8584 ("Y"), E.8655 ("Z"), E.8660 ("V"), E.8665, E.8685, E.8687, E.8758 ("R"), F.979. *Used by No. 84 Sqn.:* E.899, E.8650, J.7854. *Used by No. 207 Sqn.:* J.7038 ("C.2"), J.7039 ("C.4"), J.7041 ("C.1"), J.7048 ("C.1"). *Used by No. 4 F.T.S.:* E.890, E.8642.

Other Machines.—E.748, E.752 and E.753 had Napier Lion engines; E.752 was used in deck-flying trials from H.M.S. *Eagle*. E.8765: used in North Russia (Dwina River), 1919. E.9664: used at Fowlmere. F.1025: No. 205 Sqn. F.2816: used at Abu Sueir. H.3488: used at Cranwell. H.3523: "P" of No. 55 Sqn. J.7814: No. 605 Sqn. J.8136: No. 603 Sqn. J.8154: "B" of No. 600 Sqn. J.8221: No. 601 Sqn. J.8223: "C" of No. 600 Sqn. J.8478: No. 601 Sqn.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Whitsun in Retrospect

THE NATIONAL AIR RACES

The First and Second Rounds—and an Air Display—at Yeadon

BOTH the first and second rounds of the National Air Races were flown off on the same day at Yeadon Airfield, Leeds, on Whit-Monday. A considerable crowd came to the airfield to watch the racing and also to see an excellent flying display which included no fewer than three formation aerobatic exhibitions of uncommon merit. A cold front was forecast to pass over Yeadon late in the afternoon, but the weather-men, no less than the race handicappers, were a little optimistic about the speed of their subject, and the front did not in fact get to Yeadon in time to spoil a fine, long day of sunshine.

As always, the races provided the handicappers with a great deal of hard work; but Whit-Monday's events gave them a rare opportunity, which they were not slow in seizing. They were able to see the result of their handicapping in the first round, note their errors and correct them straight away for the second round. In all cases, therefore, the second round was quite an exciting affair, and in three out of the four races it really looked as if the handicappers might finally win and bring all the aircraft across the finishing line together.

There are four races this season for the Goodyear Air Trophy, the Osram Cup, the Kemsley Challenge Trophy and the S.B.A.C. Challenge Cup.

At Yeadon they were flown respectively over three, four, three and four laps of the near-square course of some 8¼ miles. Most of the circuit was in sight of the spectators. The second round was flown at intervals during the afternoon's air display, the first round having been completed during the morning, between 10 o'clock and midday. Each race was arranged with eight entrants so that the winner would always receive the same number of points (20). In this way the points scored towards the year's championship were directly proportional to the places gained and not affected by the number of aircraft flying in each race.

Entrants for the Goodyear race comprised five Tiger Moths, the Miles Whitney Straight, the Miles M.18 owned by F/O. H. B. Iles of R.A.F. Jever and David Ogilvy's tiny black Comper Swift. First off was F/O. A. G. Oldham in a Tiger Moth. It is difficult to work up great enthusiasm about racing with Tiger Moths until and unless a real battle develops on the last leg; but it is remarkable that these aircraft often get driven round a course at just over 100 m.p.h. In this race the M.18 (2 min 42 sec handicap) and the Swift (3 min 2 sec) overhauled the whole field and came in first and second. Unfortunately N. D. Norman missed part of the briefing in the morning and had to withdraw from the first round.

"Flight" photograph

Fred Dunkerley ready for action in his Sparrowjet. In the second round of the S.B.A.C. Cup race he won splendidly, gaining the lead during the last lap.

The Osram Cup—presented by the General Electric Company—is for a new race this year. The entrants comprised two Geminis, three Proctors, J. R. Johnston's Miles Hawk Trainer, Nat Somers' familiar Chipmunk and J. E. G. Appleyard's tiny Chilton, G-AFSV. Fastest of them all was E. Crabtree's Gemini 3, a highly polished pale blue machine with Gipsy Majors; but although it made a speed of 152.5 m.p.h. and completed the four laps over a minute faster than any other aircraft, it was considerably over-handicapped and did not manage to catch the rest of the field. By the second lap six aircraft were very close together and the Chilton was still holding its take-off lead; but it could not keep it and was beaten back into seventh place.

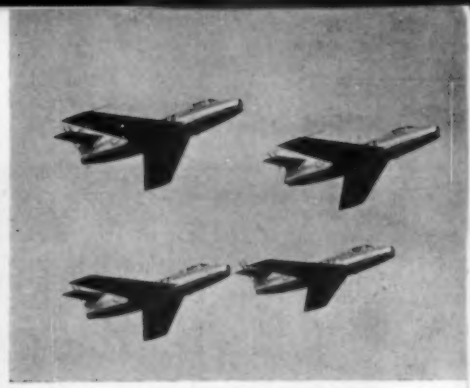
The Kemsley Trophy race, flown over three laps, was another predominantly Tiger Moth event. Again the fastest aircraft, W. P. Bowles' Miles Monarch, was over-penalized at 3 min 23 sec and came in last. The scratch man, S/L. D. P. Boulnois, commander of the first Beverley squadron, made a spanking 99 m.p.h. in the No. 47 Sqn Flying Club Tiger and held his lead to finish first. C. Gregory's Taylorcraft Plus D made a highly respectable 108.5 m.p.h. to take fifth place.

Traditionally the fastest race is that for the S.B.A.C. Challenge Cup. The slowest aircraft in it, the Proctor 3s of W/C. R. H. McIntosh and E. Crabtree, each made 138.5 m.p.h. Fastest in this first round was P. S. Clifford in Fred Dunkerley's Mew Gull at 190.5 m.p.h., but again the speed could not beat the handicap and the Mew Gull came in sixth. Fred Dunkerley, needing plenty of take-off run in his Sparrowjet, started on the longer runway at right angles to the one in use and made only 179 m.p.h. to come in seventh. The three Proctors, with W/C. McIntosh at scratch, were beaten into first place by G. C. Marler's Miles Falcon 6. Ron Paine in the Hawk Speed 6 cut a pylon and retired in the second lap.

The entrants for the second round were the same as those for the first round and the races were flown in the same order. But the handicappers had made haste during the lunch hour to adjust some of their estimates, with the result that many of the faster aircraft which had been sorely over-handicapped in the morning were able to compete most earnestly for the first places in the afternoon. The Goodyear race provided a breakneck finish in a tight bunch. F/O. Oldham just made it in his Tiger Moth, with David Ogilvy's Comper Swift thrashing along purposefully

"Flight" photographs

(Upper picture) F/O. H. B. Iles, from Jever in Germany, crossing the finishing line in first place in the first round of the Goodyear Trophy race. Two years ago F/O. Iles and a fellow officer flew this aircraft to Rhodesia. (Lower) F/O. A. G. Oldham, scratch man in both rounds of the Goodyear Trophy race, held his lead to win in the second round, passing the finishing line very low.



"Flight" Photographs

(Left) The line-up of aircraft beside the north-south runway during the day. The D.H. Dragon was giving joy rides. (Above) The Mystère 4s of the Patrouille de France.

Whitsun in Retrospect

THE NATIONAL AIR RACES . . .

behind him. The Swift would have overtaken the fleeing Tiger in another quarter mile or so.

In the Osram Cup race the handicaps were considerably adjusted, though the Chilton remained at scratch. Although Nat Somers had two seconds longer to wait than on the previous occasion, he worked his way steadily into second place in the second lap and first place in the third lap. This he held while everybody else overhauled the little Chilton with the exception of E. N. Husbands, who missed a pylon and was disqualified early in the race. This was a perfect demonstration of racing flying by Somers, whose turning technique is always faultless. In one case particularly he brilliantly overtook another aircraft actually in the turn round the first pylon, mainly because he spent less time in the turn than the other competitor and knew exactly how to get the best advantage out of a dive. In cornering he was perhaps only equalled by David Ogilvy in the Comper Swift.

In the second Kemsley race the morning's handicaps were also adjusted and there was a very close finish. It is notable that not one of the relatively low-powered group of aircraft entered got round at less than 100 m.p.h.

In the S.B.A.C. Cup race everybody except Marler had his handicap stiffened, if only by a matter of a second or two. The result was highly satisfactory. Fred Dunkerley took off this time on the normal runway and forged ahead to win by about 700 yd at the very respectable speed of 197.5 m.p.h. The Mew Gull, only slightly slower at 195 m.p.h., unfortunately could not make up its handicap and came in last. Marler's Falcon 6, with its start advanced by three seconds, rushed into second place, just beating Crabtree's Proctor. W/C. McIntosh flew skilfully, as his 23,000 air hours would lead one to expect, but could not hold his take-off lead and came fourth.

FIRST ROUND RESULTS

Pilot	Aircraft	H'cap m. s.	Speed m.p.h.	Place	Points
Goodyear Trophy					
H. B. Iles	Miles M.18/2 ...	02 42	127	1	18
D. F. Ogilvy	Comper Swift ...	03 02	126½	2	16
A. G. Oldham ...	Tiger Moth ...	00 00	100	3	14
Miss A. Windle ...	Miles W. Straight	02 24	115	4	12
N. H. Jones	Tiger Moth ...	01 26	100	5	10
P. Vanneck	Tiger Moth ...	00 40	98½	6	8
B. Haile	Tiger Moth ...	01 08	100	7	6
Osram Cup					
A. Barker	Proctor 3 ...	00 50	140	1	18
J. R. Johnston ...	Hawk Tr.3 ...	00 35	137½	2	16
T. G. Knox	Proctor 3 ...	00 50	138½	3	14
J. N. Somers	Chipmunk ...	00 44	136	4	12
P. Blumire	Gamini 1a ...	00 35	134	5	10
E. N. Husbands ...	Proctor 1 ...	01 02	136½	6	8
J. E. G. Appleyard ...	Chilton D.W.1a	00 00	126½	7	6
E. Crabtree	Gamini 3 ...	03 07	152½	8	4
Kemsley Trophy					
D. P. Boulnois ...	Tiger Moth ...	00 00	99	1	18
J. M. Donald	Tiger Moth ...	00 20	101	2	16
B. J. Snook	Tiger Moth ...	00 24	101½	3	14
J. C. Lovegrove ...	Tiger Moth ...	01 14	106½	4	12
C. Gregory	T'craft Plus D ...	01 31	108½	5	10
J. H. Denyer	Auster J.1N ...	02 31	115	6	8
A. J. Spiller	Autocrat ...	01 28	105½	7	6
W. P. Bowles ...	Monarch ...	03 23	120	8	4
S.B.A.C. Cup					
G. C. Marler	Falcon Six ...	02 07	163½	1	18
R. H. McIntosh ...	Proctor 3 ...	00 00	138½	2	16
A. S. K. Paine ...	Proctor 1 ...	00 40	144½	3	14
J. Rush	Falcon Six ...	02 18	161	4	12
E. Crabtree	Proctor 3 ...	00 34	138½	5	10
P. S. Clifford	Mew Gull ...	04 42	190½	6	8
F. Dunkerley	Sparrowjet ...	04 13	179	7	6

Full results, including speeds and the points scored towards the year's championships are given in the accompanying tables. In each case the first place carried a prize of £100, the second £50 and the third £25. Now in the leading position in the air racing championship is Marler, with an aggregate of 36 points and he is closely followed with 34 points by J. M. Donald, S/L. D. P. Boulnois, F/O. H. B. Iles, David Ogilvy and F/O. A. G. Oldham. There is, of course, ample margin for these placings to change in the final round at Coventry on July 21.

The Yeadon Display. The items of the air display, interspersed between the flying of the second round of the races, were of a very high quality. They included fly-pasts and demonstrations by four Meteor 8s of No. 609 (West Riding) Sqn., R.Aux.A.F., four Canberra T.4s of No. 10 Sqn. (these aircraft also appeared at Speke and Hucknall) and by three Shackleton 2s of No. 204 Sqn. Excellent individual aerobatics were performed by G/C. Beaman of the Yeadon Club in a Tiger Moth, by a Chipmunk of the Leeds University Air Squadron and by J. S. Armstrong in an Olympia sailplane of the Derbyshire and Lancashire Gliding Club.

Impressive—and disquieting—was the performance of Mlle. Andrée Jan on a trapeze suspended from a Bell 47 helicopter piloted by John Crewdson. Clad in a red-and-white-striped bathing dress, her shapely figure flicked and twisted around the trapeze bar as the helicopter moved slowly along in front of the crowd. Expertly she appeared to fall from the trapeze, catching herself by a hand or foot, but her most alarming effort was to hang by her teeth from the trapeze bar as the helicopter flew quite fast about 200ft up.

Alain Hisler once again brought the Minijet from St. Yan and, having already performed at two other air displays, he produced at Yeadon the polished and remarkably precise aerobatic display which we have now come to expect of him. The precision and crispness of the flying of this representative of the French *haute école* are like a breath of fresh air in these days of 5,000ft-high loops and 500-kt passes of jet aerobatics.

A Valiant had been scheduled to appear, but the R.A.F. regretted that the type was not at the moment flying. Also absent was the surprise item listed on the programme; and no hint was given as to what it would have been if it had not been surprisingly absent.

Left until now for special mention in this account are the performances put up by the three formation aerobatic teams which took part, namely that from No. 43 Sqn. at Leuchars (four Hunter 4s), the Acrojets of the 7330th Flying Training Wing (M.D.A.P.) U.S.A.F., from Fürstenfeldbruck, Germany (four T-33s), and the Patrouille de France (four Mystère 4s) from the 12e Escadre of the French Air Force at Cambrai. The No. 43 Sqn. team has already gained a fine reputation for its performances—particularly that before the Russian visitors at Marham. [An article by one of its members appears in this issue.] At Yeadon they gave an immaculate demonstration which was tight, smooth, fast and well-positioned. They changed formation during a loop into line-astern and then into echelon starboard; they looped again and changed into box formation, and then rolled from line-astern into box. A new wrinkle was to dive off the top of a loop in echelon and then to make a very fast individual quarter roll, thus changing direction and going into a line-astern. They signed off in masterful fashion by trailing red smoke all the way down from the top of a loop in box and pulling up for a most satisfying bomb-burst.

The Acrojet team spent most of their time in an exceedingly close box formation with their tip tanks emphasizing a characteristically cruciform layout. They made their entries stealthily from behind the crowd, and, passing about 50ft above head level, pulled

"Flight" photographs

(Left) David Ogilvy in the Comper Swift; he came second in both rounds of the Goodyear Trophy race. (Right) the tip-tanked T-33s of the U.S.A.F.E.'s Acrojets aerobatic team.

up into a perfect roll-off-the-top. They placed the low point of each manœuvre in front of the crowd, a feature which holds attention well. On one occasion they half-rolled in box and reversed the direction of the roll to regain level flight. They began one loop in echelon starboard and rolled off the top into box formation before signing off with a vertical upward bomb burst. The peacefulness of their passing was rudely shattered seconds later when all four aircraft arrived together over the runway from the four points of the compass, none of them more than 40ft above the ground. From the control tower we looked down into the leader's cockpit as he passed and saw certainly the colour of his bone-dome if not the colour of his eyes. His identity, we later discovered, was Maj. M. Smolen.

The last item on the programme was the aerobatic display of the Patrouille de France, official aerobatic team of the Armée de l'Air. They were led by Lt. Tourniaire. They converted comparatively recently to Mystères from Ouragans and were obviously not quite so accustomed to their new aircraft as No. 43 Sqn. to the Hunter. The sensitivity of their controls was clearly evident in frequent slight porpoisings similar to those one has come to expect in a Sabre aerobatic team. From certain directions the aircraft did indeed resemble the Sabre's successor, the North American F-100. They kept perhaps closer to the airfield than the other two teams, but in so doing they lost some of the freedom of manœuvre which the others had enjoyed. However, they went through the full gamut of loops, rolls and rolls-off-the-top and frequently changed formation. Their demonstration was a fitting conclusion to a fine afternoon's flying.

Of the three teams, British, American and French, one would say that the British were enterprising, complicated and showed superb airmanship; the Americans were spectacular and precise, but not so varied; and the French team were relatively new to their aircraft and to this country, and their flying was not quite so well co-ordinated.

SECOND ROUND RESULTS

Pilot	Aircraft	H'cap m. s.	Speed m.p.h.	Place	Points total
Goodyear Trophy					
A. G. Oldham ...	Tiger Moth ...	00 00	103	1	34
D. F. Ogilvy	Comper Swift ...	03 00	127½	2	34
H. B. Iles	Miles M.18/2 ...	03 27	132	3	34
N. D. Norman ...	Tiger Moth ...	00 44	106½	4	14
N. H. Jones	Tiger Moth ...	01 18	109½	5	22
Miss A. Windle ...	Miles W. Straight	02 14	117	6	22
B. Maile	Tiger Moth ...	00 59	107	7	14
P. Vanneck	Tiger Moth ...	00 33	103½	8	14
Osram Cup					
J. N. Somers... ...	Chipmunk ...	00 49	139	1	32
E. Crabtree	Gemini 3 ...	03 00	162	2	22
J. R. Johnston ...	Hawk Tr.3 ...	00 49	137	3	32
P. Blamire	Gemini 1a ...	00 30	134	4	24
T. G. Knox	Proctor 3 ...	00 58	137½	5	26
A. Barker	Proctor 3 ...	01 18	139	6	28
J. E. G. Appleyard ...	Chilton D.W.1a	00 00	126½	7	14
E. N. Husbands ...	Proctor 1 ...	01 04	138½	Dis.	8
Kemsley Trophy					
J. H. Denyer... ...	Auster J.1N ...	02 06	118	1	28
J. M. Donald... ...	Tiger Moth ...	00 07	101½	2	34
D. P. Boulnois ...	Tiger Moth ...	00 00	100½	3	34
C. Gregory	T'craft Plus D ...	01 14	109	4	24
B. J. Snook	Tiger Moth ...	00 11	101½	5	26
W. P. Bowles ...	Monarch ...	02 37	119½	6	14
J. G. Lovegrove ...	Tiger Moth ...	00 56	105	7	20
A. J. Spiller	Autocrat ...	00 56	104½	8	12
S.B.A.C. Cup					
F. Dunkerley... ...	Sparrowjet ...	04 03	197½	1	26
G. C. Marler... ...	Falcon Six ...	02 10	163½	2	36
E. Crabtree	Proctor 3 ...	00 23	143	3	26
R. H. McIntosh ...	Proctor 3 ...	00 00	139	4	30
R. R. Paine	Hawk Sp. Six ...	03 18	179	5	12
A. S. K. Paine ...	Proctor 1 ...	00 31	143	6	24
J. Rush	Falcon Six ...	02 08	161	7	20
P. S. Clifford... ...	Mew Gull ...	04 28	195	8	14

100,000 AT SPEKE DISPLAY

WHIT-MONDAY in the North-West brought a crowd of over 100,000 spectators to jam Liverpool's public-transport services and sample the international air display at Speke Airport. The tragic fatal accident to Léo Valentin which marred the display towards the end of the programme was not known to many of the spectators at the time, who had enjoyed a pleasant afternoon's flying. The display, sponsored by the *Liverpool Echo*, is believed to have realized a useful amount for the funds of the Soldiers', Sailors' and Airmen's Families Association.

The afternoon was warm and sunny, with an on-shore breeze fanning in from the Mersey, across which the Wirral peninsula was hazily visible. The programme began at the very beginning of aviation, almost, with a hesitant flight across the aerodrome by the 1910 Deperdussin of the Shuttleworth Collection, flown by Jeffrey Quill. After a Naval Dragonfly had been shown off in all directions by Lt-Cdr. Laurence Tivy from R.N.A.S. Anthorn, one of the day's most sparkling performances came from Alain Hisler, runner-up in last year's Lockheed aerobatic competition, in his Sipa Minijet. An inverted run across the field preceded a lively selection of fast runs, rolls and figures of eight which delighted the crowd but agitated a number of the aerodrome's resident hares in the open grass area. Hisler later took off again to give further precise performances at Yeadon and Hucknall.

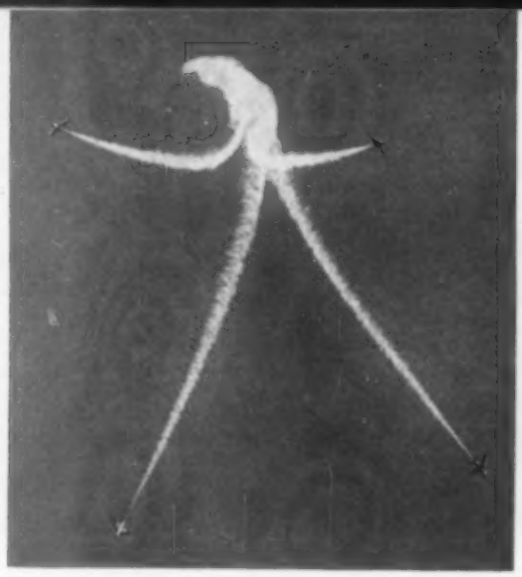
Eight Vampire F.B.5s of 613 "City of Manchester" Auxiliary Squadron, led by S/L. Jack Wales of Avro, next proved that Mancunian week-enders can formate as well as most regulars. This was followed by Léo Valentin's first appearance on the programme, in a long-delayed parachute drop from a Rapide. Contrast was provided by Gerard Smith, C.F.I. of the Derby and Lancs Gliding Club, who eased his Slingsby Sky into elegant aerobatics before coming in for a low beat-up and the customary well-judged landing next to the sailplane's trailer.

Five Attackers from No. 1831 R.N.V.R. Squadron (R.N.A.S. Stretton) were next responsible for a well-timed performance, four in formation (led by Lt. P. Barlow) giving some neat formation changes and a pretty red-trailed breakaway, and the solo man (Lt-Cdr. P. L. V. Rougier) giving the crowd the shock of its life by bursting in fast, low and unexpected. Jeffrey Quill, this time in a Spitfire V, then gave a surprising reminder of the machine's performance with Farnborough-style climbing rolls, and an excellent view of the once-familiar elliptical planform in a wide circuit of the airport.

The name "Skyblazers" has justly become linked with perfection in close-formation aerobatics, and the performance of the talented quartet of U.S.A.F. pilots in their F-86F Sabres at Speke demonstrated the reason yet again. An exhilarating succession of rolls, loops, formation changes during rolls and loops, and plain, honest top-quality tight-formation work in general was presented. The group's very precision and professional steadiness made its display seem almost easy—that is, until the smoke-trailing "bomb burst" break-away and the final low-level, high-speed, four-point crossover jerked the crowd back to its feet and reality.

The Skyblazers team, from the 48th Fighter/Bomber (Statue of Liberty) Wing, based at Chaumont Air Base, France, consists of Capt. James S. Reynolds, 1st Lt. James L. Foster, 1st Lt. Harold A. Homan and 1st Lt. Warren L. Efting.

The flying programme, bearing little relation to that printed in the official display programme, continued. The next item was a "parachute race," described as "a novel event which has not been staged before in this country"—which was not really surprising.



"Flight" photographs

(Left) The Skyblazers' smoke-trailing bomb-burst which concluded their demonstration at Speke; the manœuvre was completed by a low-level cross-over. (Above) Chronological contrast in structures—the Speke terminal building and the 1910 Deperdussin of the Shuttleworth Collection.

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100,000 AT SPEKE . . .

Mr. J. T. Basnett and Mr. G. D. Sykes were the contestants who, having each descended by parachute from about 2,000ft, were required to divest themselves of their harnesses and race on foot to a Land Rover parked in the centre of the field. From the terminal building, it appeared that the finish was a dead heat.

A stately fly-past by four Canberra T.4s of No. 10 Squadron (led by F/L. Ernest Lack) was followed by a brisk display of formation aerobatics by four Sea Hawks of 767 Naval Air Squadron, a training unit based at Ford. Led by the squadron C.O., Lt-Cdr. Gilbert Newby, the team finished its show with a spirited rolling break-away.

A short demonstration flight by a Blackburn Beverley flown by F/L. Titman of No. 47 Sqn. preceded aerobatics by four Meteor F.8s from No. 12 Group of Fighter Command. Based at Horsham St. Faith, the team comprised S/L. K. N. Haselwood, F/L. "Chuck" Sewell, F/L. B. O. Walpole and F/O. Duncan Allison. As they completed the demonstration, Starways Dakota G-AMPY taxied out for take-off, the bright orange wings of Léo Valentin visible just forward of the open port-side door-space.

Landings by a B.E.A. Pionair and an Airwork Viking, and positioning movements by Austers of the Merseyside and North Wales Flying Club took place while Valentin's aircraft circled, gaining height. It was Valentin's intention, after jumping from the Dakota at 9,000ft, to glide for several miles, using his new pair of wooden wings fitted with ailerons, before parachuting down to the aerodrome.

His previous experience had included a three-mile flight from 10,000ft made with similar 8ft-span wooden wings in France in 1954. He had been a parachutist with the French Armée de l'Air during the war, and in 1948 made a world-record delayed parachute drop without oxygen (from 22,000ft with a delay of 109 sec) at Pau. His demonstrations of "birdman" gliding began in 1950.

The Dakota carrying Valentin was flying a few miles north-east of Speke at about 9,000ft when, at 4.23 p.m., a figure was seen to drop from the aircraft. The sun glinted on an orange wing, and a parachute "candled" and trailed behind. With his wings spinning continuously, Valentin continued to fall vertically until lost to sight behind an airport hangar. The Dakota descended and circled the area where he had dropped.

It was subsequently learned that Valentin had fallen in a cornfield at Halewood, two miles away, and that his fall had been fatal. Observers in the Dakota reported that, on leaving the aircraft, Valentin had apparently been caught in the slipstream, his wing had been damaged against the fuselage, and he or his wing had struck the tailplane. No mention of the accident was made over the public-address system of the airport, and, as the fall had taken place some distance away, many of the spectators were unaware of it on leaving at the end of the display.

There remained two items on the display programme. In the first of these, Dragoljub Aleksic dug his teeth into a ladder attached beneath a Tiger Moth and, thus suspended, flew past waving the Jugoslav flag and the British civil air ensign at a surprised crowd. For the final item, smart red-and-white Austers of the Merseyside and North Wales Flying Club flew past in formation.

THE U.S.A.F. "AT HOME"

THE Saturday of the Whitsun holiday was U.S. Armed Forces Day, and in this country, as in America, the U.S.A.F. marked the occasion by opening a number of its bases to the public. This account of a visit to Sculthorpe may be taken as typical of what was to be seen at the major airfields, if not at the smaller establishments.

THE decision of the U.S.A.F. to ban flying displays on Armed Forces Day kept nobody away from the 47th Bombardment Wing's "open house" at R.A.F. Sculthorpe on Saturday, May 19. By mid-afternoon, the previous attendance record of 20,000 had been surpassed, and there were long queues waiting to troop through the transport aircraft lined up on display—and through the tents from which hamburgers and genuine American canned beer were being dispensed.

Here, perhaps more than at any other U.S.A.F. base in Britain, this year's theme of "Partners for Peace" was no mere catch-phrase. When great tidal floods smashed the coastal defences of East Anglia in 1953, crews of the 47th Wing's 19th Tactical Reconnaissance squadron made a speedy photo-reconnaissance of the flooded areas in their RB-45C Tornadoes, whilst their colleagues joined in rescue work on the ground.

To mark this good neighbourliness, the people of Norfolk presented the Wing with a "silver pheasant" trophy, and this was displayed prominently in one of the two exhibition hangars, together with P.R. photographs, on which the locals had great fun identifying their homes.

Other exhibits included a range of survival equipment, P.R. cameras, guns, a Radioplane OQ-19D target drone, a 36-bed air-transportable hospital unit, and a chaplain's section displaying a portable organ and altar "field sets" to an accompaniment of quiet religious music from a tape recorder.

The second hangar, containing the base maintenance shop, was designed to appeal particularly to small boys. Visitors were invited to try their hand at riveting; and they were able to produce most satisfying bursts of compressed-air "gunfire" by aiming and firing the twin point-fives of a B-45 rear turret mock-up which is used for bench-testing components of the A-6 fire-control system. Those who wanted even more noise were transported by coach to watch a J47 turbojet being run up in the test-beds.

The outdoor show began with a march-past by 2,000 members of the base personnel, who were reviewed by Maj-Gen. Roscoe Wilson, commanding the U.S. 3rd Air Force, and A.V-M. Cross, A.O.C. No. 3 Group of the Royal Air Force. Afterwards, the visitors were able to inspect every kind of ground vehicle and fire appliance used at the station, and some 20 different types of aircraft.

Most interesting of these were a B-47E Stratojet of the 97th Bombardment Wing from Upper Heyford, complete with its new 1,700 U.S. gal. Fletcher under-wing drop tanks, and its accompanying KC-97G tanker from Greenham Common, with white-topped flight deck, Arctic red fin and pale blue star-spangled S.A.C. band around its rear fuselage. A KB-29P Superfortress flying-boom tanker attached to 47th Wing sported a new black radome above its rear fuselage. This apparently contains semi-experimental equipment which computes the range and bearing of an approaching "receiver" aircraft, in conjunction with I.F.F.-type signals transmitted by the "receiver."

Other 47th Wing aircraft included a B-45A of the 85th Bomber

"Flight" photographs

Seen at Sculthorpe: an F-86D all-weather intercepter with rocket pack extended and (right) nose of an RB-45C strategic recce. aircraft.

Squadron; an RB-45C of the 19th Tactical Reconnaissance Squadron; a B-26 target tug with a red sleeve target streamed behind it; and a variety of aircraft from the 47th Operations Squadron, including a T-33A, C-47, T-29A and two C-119Cs. An F-84F Thunderstreak and an F-86D Sabre completed the U.S.A.F. representation.

R.A.F. aircraft on static display were a Hunter F.1 from C.F.E., West Raynham, Hastings C.2 of No. 24 Commonwealth Squadron from Abingdon, Vampire T.11 from Oakington, Venom N.F.3 of 23 Squadron from Coltishall, a Provost, Chipmunk and Auster T.7. Finally there were two U.S. Army exhibits in the form of an L-20 Beaver liaison aircraft and a 75 mm Skysweeper radar-controlled anti-aircraft gun from the unit for which the 47th Wing fly B-26 towed-target missions.

HUCKNALL ROLLS

THE Midlander is traditionally hardy and optimistic, and a somewhat depressing weather forecast on Whit-Monday did not deter a very large crowd from changing the face of the Rolls-Royce airfield at Hucknall, for the third annual air display organized by the Eastern area of the Royal Air Forces Association. The threatened front did not materialize and a cloudless sky gave excellent weather for the event, though a chilly 10-kt wind blew diagonally across the runway.

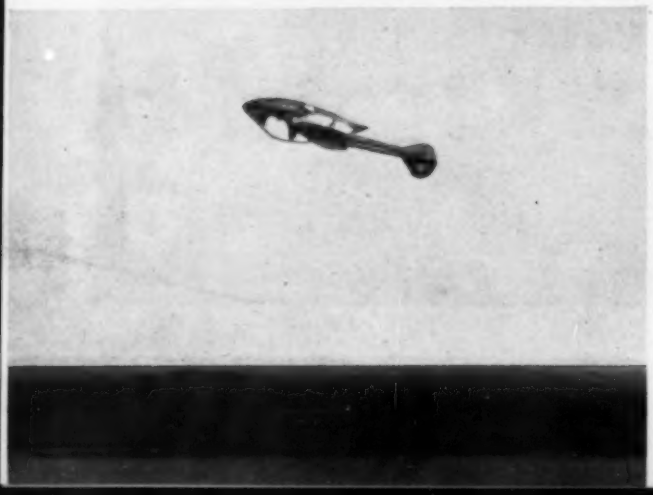
Stimulating aerobatics were the keynote of the flying display which began at 2.30 p.m., but the airfield had been open at 11 o'clock in the morning to give the visitors time to settle down, refresh themselves, inspect a comprehensive exhibition of Rolls-Royce engines and equipment, and go for joy-rides in a Derby Aviation Marathon and Rapide.

The flying programme opened with solo aerobatics in a Meteor flown by F/L. E. F. Smeeth, training officer of 504 (County of Nottingham) Squadron, R.Aux.A.F. The Meteor was thrown round the sky in a most exhilarating fashion, starting with a high-speed climb into a loop, followed by another climb and roll off the top—then another loop and roll off the bottom, so completing a vertical figure of eight. F/L. Smeeth executed tight turns, a very nice slow roll and then an eight-point roll, considerable verve marking his display, which also included the steep climbs which appear so effortless in jet-powered aircraft.

Complete contrast came with the next item, heralded by the somewhat elephantine but impressive approach of a Bristol Freighter of No. 137 Transport Flight, R.C.A.F. The Freighter landed to take on a typical piece of cargo—in this instance an Orenda engine in a special container. A fork-lift truck bore the container to the great open maw of the aircraft, and an R.C.A.F. ground party handled the whole operation in about three minutes, after which the loaded aircraft took off and flew past on one Hercules engine, just to show how easy it all was. Immediately afterwards, Mr. A. E. Coltman, C.F.I. of the Leicestershire Aero Club, took up an Auster to show what the light aircraft can do. He demonstrated it with a take-off into wind over the grass, a low, fast run over the field, some steep turns and some highly eccentric, wing-waggling flying, before turning into wind once more for his landing.

A ten-second-delay parachute drop by Mr. J. N. Hoffman was excellently judged, in spite of the wind, so that he landed in the centre of the field. Almost at once the Canberra T.4 formation which also appeared at Speke came over, flying at about 750ft.

Next came a highlight—the arrival for an aerobatic demonstration of Alain Hisler in the Sipa Minijet. This delightful little machine landed to deposit M. Hisler's engineer and then took off (making a noise exactly like a grown-up jet aircraft) for a most polished display. M. Hisler began with an inverted fly-past along the runway, just as the Gull glider was towed off ready for the next item. Then the Minijet was slow-rolled and climbed for altitude; next came a fast fly-past and so over the top of a loop and down to the runway and again into another loop, followed by a horizontal figure of eight. A climbing turn and a loop were succeeded by a very low fly-past, an aileron turn and another low run. A precise eight-point roll indicated the superb aileron control, and some credit for the demonstration must be



(Right) Fine formation keeping by the Canberra T.4s as they arrived at Hucknall. (Below, left) Alain Hisler makes a low inverted pass in the Sipa Minijet. (Below, right) This view of the Skyblazers, obtained at Hucknall, shows the starred colour scheme on the F-86Fs' wings.

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HUCKNALL ROLLS . . .

given to the splendid vision afforded by the Minijet's cockpit.

Two green Very lights now signalled the glider to cast off from its tug. Mr. F. Breeze, of the Derby Gliding Club, in the Gull which he built himself, started with a spin, followed by a very tight loop, then another loop, and a stall turn. Thermals from the runway made height-retention relatively simple for Mr. Breeze, who ended a satisfying display with two tight turns, landing right in front of the public enclosure and exactly alongside his tow-car.

For artillery spotting by No. 664 Air.O.P. Squadron, R.Aux.A.F., an Auster 6 was flown by the Squadron's C.O., Maj. A. R. Robertson, who took off and spotted for the 25-pounder guns. Their target was three heavy trucks, and the spotting aircraft flew low until the pilot was ready to gather information for the gunners. He then climbed to about 500ft, descended to about 250ft, and signalled range and, subsequently, corrections, until the gunners got their range and stopped the trucks.

Three Shackletons of 204 Squadron, Coastal Command, then flew over, and a majestic sight they were. After the first fly-past they separated, and the first aircraft did a low, fast run, the second came over with the two starboard engines stopped, whilst the third demonstrated a slow run with wheels and flaps down and bomb doors open.

The three trucks just mentioned now did duty as targets for flour-bag bombing by three Austers of the Leicestershire Aero Club, flown by Messrs. Coltman, True and Riga. Meanwhile, Meteor 8s of 504 Squadron were running up, and after radio checks and wind speed information from the tower they taxied out for their formation aerobatics. After taking off, they formed up in two boxes of four with an odd man out. The soloist started with a loop and a fast run. He made a circuit and came in from the opposite direction. A half-roll was followed by a tight turn, which was repeated as the others came over in arrow-head formation. The single aircraft then returned with a climbing turn and vertical half-roll and a neat loop. As he made a fast run over the crowd, the formations came back in two echelon groups, then broke up to make individual fast runs—one machine inverted, and the others breaking away to port and starboard to complete a very exciting display.

An Auster J4 was then demonstrated for its manœuvrability and handling qualities by Mr. Riga (an ex-Luftwaffe pilot), now assistant C.F.I. at Leicester. Meanwhile the U.S.A.F. Sky-blazers, led by Capt. James S. Reynolds, were waiting to start their act, and a very fine one it was. The F-86Fs arrived in line astern and, as usual, leaving their trails behind them. They gave the crowd "the lot," changing formation on the top of their loops, doing most of their aerobatics in a very tight diamond formation; a beautiful barrel roll in this formation was followed by another for which they changed to echelon starboard, then changing back to diamond as they went through another perfect roll. Their display ended with the famous "bomb burst" and the four machines flying low over the runway from the four points of the compass.

The afternoon was rounded off with another superb demonstration, this time by the Hunter Mk 4 aerobatic team of No. 43 Squadron. Led by F/L. P. Bairsto, they started with a couple of loops and a nice formation change from box to echelon starboard. Then followed another loop and formation change to box, a tight turn round the airfield and change to line astern for a climbing roll. A few more changes of formation and, after an immaculate display, the Hunters released red smoke on the top of a roll before breaking up with each machine doing a separate roll. In comparison with the Skyblazers their manœuvres were, it seemed, slightly better positioned relative to the field and crowd, but both formations were flown with immense *panache*, indicative of great skill and much hard work.

IRELAND'S BIGGEST-YET AIR DISPLAY

WHITSUN week-end saw an excellent two-day air display staged by the Aero Club of Ireland at Weston Aerodrome, some nine miles outside Dublin. It was the largest event of its kind ever to be held in the Republic and, with a varied and interesting programme, it drew crowds well over the 100,000 mark.

The opening item was a demonstration of an Aer Lingus Viscount, showing the magnificent handling properties and high inherent safety-factor of the Vickers-Armstrongs airliner. This was followed by a formation flight of the club's Tiger Moths, which maintained position remarkably well from start to finish despite somewhat adverse weather conditions, particularly on the second day.

Aerobatics by individual club members and an interesting demonstration of gliding ushered in the fifth and perhaps most polished and spectacular event of the programme. This was the 15-minute turn by three Spitfire Trainers and a Provost of the Irish Air Corps. It was a demonstration of considerable skill, the three fighters going through the most intricate manœuvres in perfect unison, and the trainer then proceeding to make low-level aerobatics look almost easy.

At the end of the Air Corps performance René Vincent took off in an Auster for a parachute jump, his departure being followed by an incident involving the "theft" of a Tiger Moth by, to all appearances, a singularly unskilled pilot. When an arrest was eventually effected, the suspect was revealed as Capt. "Darby" Kennedy, the C.F.I., and the policeman as two club pilots.

M. Vincent then carried out his scheduled jump, using three 'chutes which he opened singly, detaching himself completely from each one before opening the next. On landing in the middle of the field he was greeted with warm applause from the appreciative crowd.

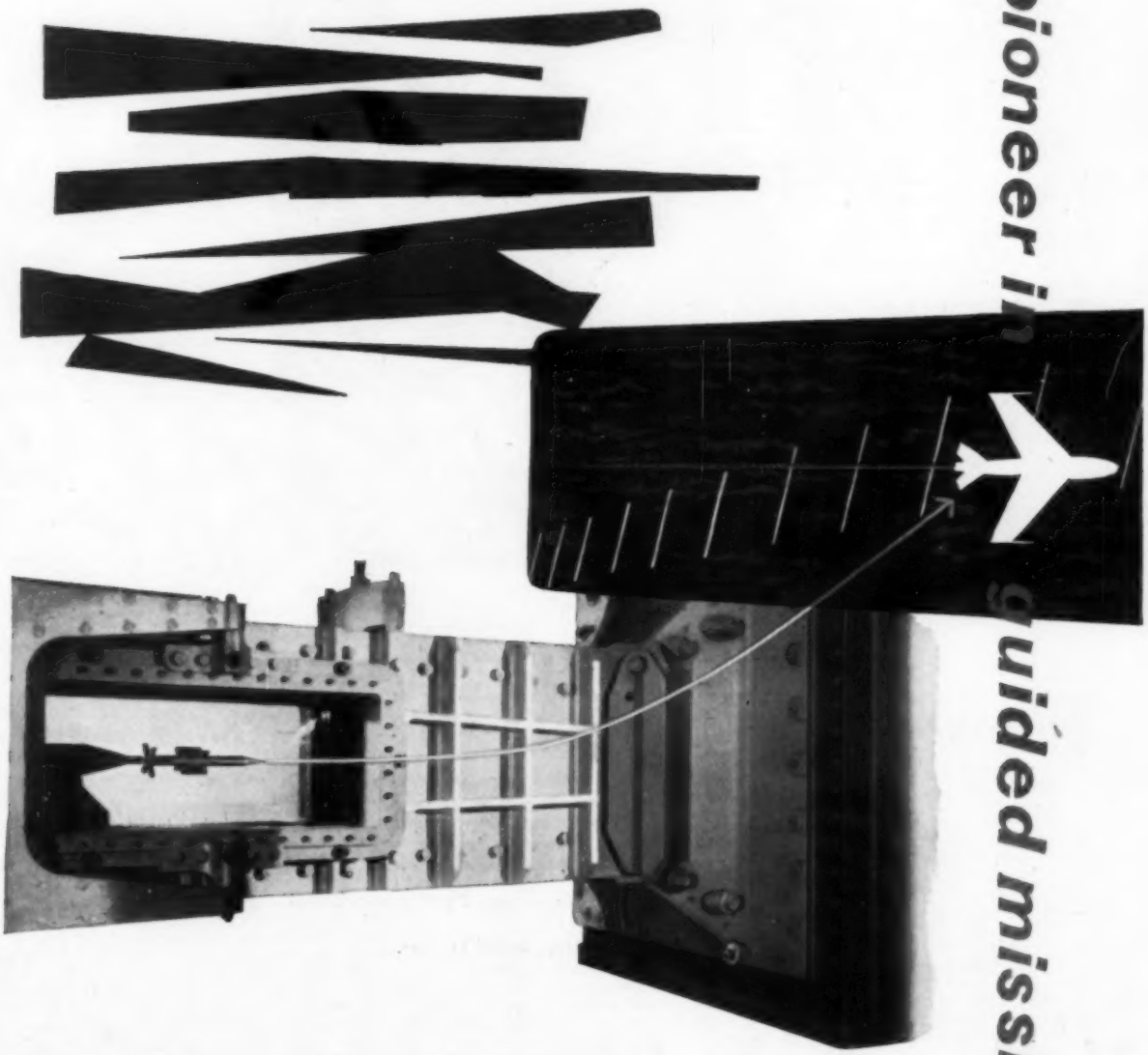
A roar now heralded the arrival of the Gloster Meteor sent by the Martin-Baker Co. to demonstrate low-level ejection as carried out for the first time last September by S/L. J. S. Fifield. On this occasion a dummy was ejected from the aircraft, which was flown by Capt. J. E. D. Scott, R.A.

A large balloon provided by the Balloon Club of Holland then gave a tethered flight demonstration, which was followed by a beautifully smooth exhibition by Ranald Porteous, the Auster test pilot, in an Aiglet.

The two remaining items were a mock attack on an "enemy" stronghold, carried out in most realistic fashion, and mass aerobatics, both items by club pilots. A noteworthy contribution was made by Capt. Kennedy's 19-year-old daughter, Rosemary, who performed a twenty-turn flat spin from 4,000ft.

Not-so-free balloon: an unusual item in the Irish programme was a captive-balloon ascent, contributed by the Balloon Club of Holland. (Below) The time-honoured "Theft of a Tiger Moth," complete with police chase, never fails to entertain air-display crowds, and Weston's effort was no exception to the rule.

A great deal of design study, development, testing and production of these vital weapons for Britain's defence is being carried out by Armstrong Whitworth. With our great resources, and backed by the even greater resources of the Hawker Siddeley Group, the requirements specified for these weapons by the Armed Forces, will be duly satisfied. Other products for the Forces of the Free World coming from Armstrong Whitworth are the Javelin, day and night all-weather fighter; the Hunter, first choice for European Defence; and the Sea-Hawk, the Royal Navy's latest fighter.



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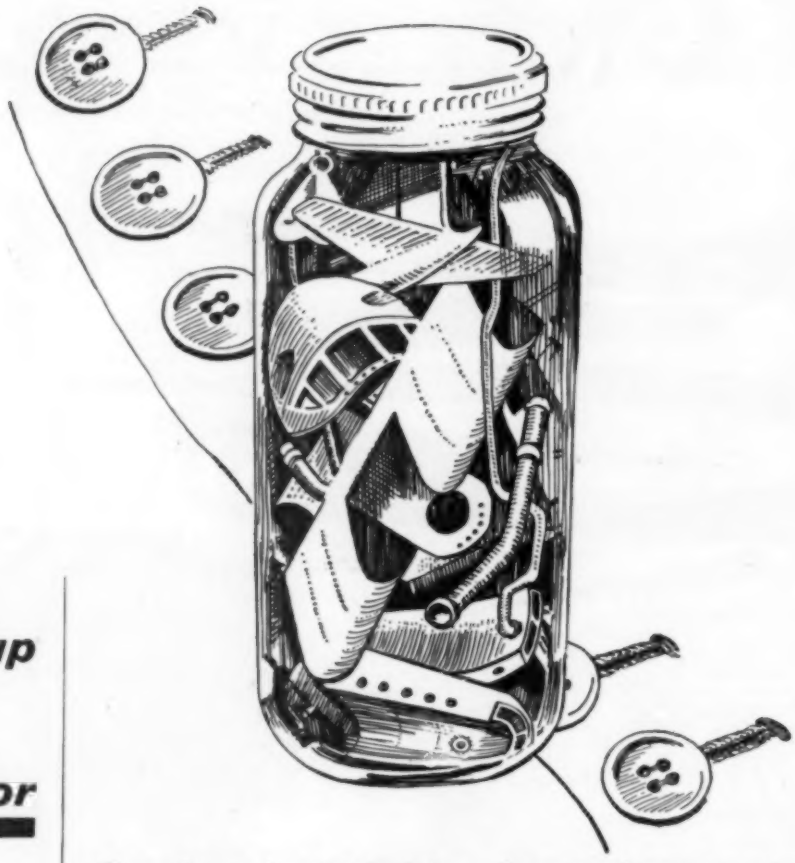

Bottled-up

or

buttoned-up?

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Frankly, we are no good at the bottling-up business, but we are certainly old hands at buttoning-up a problem — in fact, for over fifty years now we have, quite literally, tackled a thousand and one different jobs, putting us in the position of being able to provide a technical service for aircraft manufacturers that is, we are proud to say, second to none.

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Newcomer to London: PanAm's third DC-7C, whose proving flight to London Airport on May 24 is the subject of a news item on the next page. The aircraft, N733PA "Clipper Blue Jacket," is seen here outside PanAm's London engineering base, posing with five new Hillman Minxes for the photographers.

CIVIL AVIATION

B.O.A.C.'s CHANGE OF FORTUNE

JUST before Sir Miles Thomas retired from the chairmanship of B.O.A.C. on April 30, he announced that the Corporation had earned a net profit of about £500,000 up to March 31, 1956 (see *Flight*, April 20). This net profit was double that of the previous year, and it appeared that B.O.A.C. was steadily regaining the ground it lost to its competitors after the Comet setback two years ago.

The news that a loss of about £1½m (including capital charges) is expected during the forthcoming financial year, given last Monday by the new chairman, Mr. Gerard d'Erlanger, came as a severe shock. It seems that, having operated without Exchequer grant since 1951, the Corporation will again require Government financial support. (The Exchequer's power to make grants in emergency recently lapsed— *Flight*, March 23—when the future finances of both Corporations appeared to be sound.) The introduction by B.O.A.C. of Britannias and DC-7Cs indicates that capital charges are certain to be heavier; and higher costs, increased wages (alone amounting to £750,000) and the low initial productivity of the new types are given as the reasons for the expected deficit.

The changes in the direction and management of B.O.A.C.'s operations, announced on May 25, will mean more efficient co-ordination between the three operations departments—flight operations, ground services, and engineering. Each of these departments will be responsible to the Board through Mr. H. O. Houchen, who is appointed Director of Current Operations. Mr. Houchen is at present deputy to Sir Victor Tait, operations director, who retires on June 30 "by mutual agreement."

No chief of flight operations has yet been appointed, but the new man will be chosen from within the Corporation. Ground services will remain in the charge of Mr. J. R. Stainton (his title General Manager Stations and Traffic is changed to Chief of Ground Services), and Mr. C. Abell, B.O.A.C.'s chief engineer, remains responsible for engineering. Each department will report direct to Mr. Basil Smallpeice, managing director, as from July 1.

It was announced at the same time that Sir Harold Whittingham will retire from the post of Director of Medical Services on June 30, although he will continue to act as medical consultant to B.O.A.C. Sir William Cushion, Supplies Manager, will retire also on September 30. In announcing these changes B.O.A.C. said: "The Corporation desires to place on record its great appreciation of the notable contributions made by Sir Victor Tait, Sir Harold Whittingham and Sir William Cushion to the progress and development of B.O.A.C. . . . to the present day."

HOW THE TRAFFIC GREW IN 1955

THE first pages likely to be opened by airlines which receive I.C.A.O.'s *Annual Report of the Council to the Assembly for 1955*, just published, are those concerning traffic trends. These show that the 1954-1955 gain was 18.3 per cent compared with 1953-1954. If the growth continues at this rate, traffic will have doubled by 1959: even if only the average rate of increase over the last few years is maintained, doubling will take only until 1960.

The largest gain appears to have been in European traffic, where an increase of about 27 per cent was experienced, 92 per cent of it on a tourist ticket. The statement in last year's report that some European short-haul services appeared to be swinging back towards first-class flights seems to have been wrong. Surprisingly, only about a third of U.S. domestic traffic was tourist, although domestic coach travel had a bigger share of the total traffic increase.

No doubt I.A.T.A., who are at present at Cannes considering the PanAm and T.W.A. transatlantic cut-rate fare proposals, will have noted the alacrity with which the public responds to fare reductions. Within one month of the introduction by American Airlines last September of the $80 coast-to-coast excursion fare, there resulted, the report records, a 58.9 per cent increase in tourist passengers over the same month of the previous year.

Perhaps the biggest increase in tourist traffic was on U.S. international services, which gained 45 per cent. North Atlantic air travel, which was 60 per cent tourist as early as 1953, went up to 71 per cent tourist in 1955. A "reasonable estimate" of tourist traffic throughout the world as a whole would, according to I.C.A.O., be that it represents about 40 per cent of the total.

100 HOURS ON THE HERALD

ROUTE analyses for the Herald have been made at the request of about 50 airlines during the past year. The prototype has now completed its first 100 hours, and is being prepared for its C. of A. trials. These facts are given by Handley Page in a progress report on their local-service airliner published today.

The second 50-hr flight-test phase included a period of intensive performance measurements of take-off, climb, level flight, landing, three-engined take-offs and climbs, and accelerate-stop distances. Development of the Alvis Leonides Major engines continues and is expected to be increased "in quick stages" to a point where the engine will be "commercially acceptable."

Performance figures which will be guaranteed to purchasers are as follows: cruising power and fuel consumption; rate of climb at take-off power on four and three engines; rate of climb at maximum continuous power on three engines; take-off balanced field length; take-off distance on four engines; and landing distance.

A second Herald prototype will fly this summer and will be used to prove the cabin pressurization and de-icing systems and for tropical trials, followed by overseas sales demonstrations. It will then spend several months in the hands of an airline.

FIGURES FOR THE Tu-104

AN edifying document, acquired at Zurich last week-end (see page 662) was a brochure, printed in French and issued by the crew of Tu-104 L5400 which took part in the display. Captain of the aircraft at Zurich was Major A. H. Starikov (who flew the aircraft in and out of London during its visits last April), and the Russians carried a Swiss pilot and a Russian-speaking American.

Details from the brochure, with figures converted from metric units, are as follows: maximum speed, 620 m.p.h.; cruising speed, 500-560 m.p.h.; maximum range (allowances not stated), 2,800 to 3,100 st. miles; cruising altitude, 32,800 to 39,400ft; take-off distance (conditions not stated), 4,600 to 5,250ft; landing distance, 3,600 to 3,930ft; payload 15,400 lb to 16,530 lb (70-80 tourist passengers), or 11,460 to 13,230 lb (50 first-class passengers); freight capacity, 5,510 lb; cabin differential pressure, 6.4 lb/sq in to 8.1 lb/sq in (maximum cabin altitude, 9,800ft).

THE SAFETY OF EUROPE'S R.T.

ON page 689 are included I.A.T.A.'s findings that present air-to-ground radio communications throughout the world fall far short of the ideal. So far as Europe is concerned this seems to be putting it mildly, and it was particularly instructive to study results of a survey of European H.F./R.T. recently carried out by the International Federation of Air Line Pilots' Associations.

This matter is especially topical because, according to an I.C.A.O. recommendation in November 1954, a general withdrawal of W.T. stations in Europe and the Mediterranean by July 1 this year is advocated. The pilots' Federation undertook their survey to ensure that, if this plan were implemented, a serious loss of safety would not immediately result.

Their findings are that existing H.F./R.T. in Europe and the Mediterranean "falls below acceptable standards of safety, and, while some individual sectors or areas may be satisfactory, the system on the whole is inadequate to bear the present H.F./R.T. communications traffic, and would be entirely unsafe if the whole of the existing air communications traffic were imposed upon it."

European airline captains were given a questionnaire to answer, together with some brief notes on the operation of H.F./R.T. (which were, incidentally, the only form of such instruction that pilots had received!). An analysis of the returns shows that, of 120 *initial* calls, 337 *actual* calls were necessary, the wastage of channel time thus being 217 calls. The causes of this wastage are, I.F.A.L.P.A. feel, the inadequacy of inter-station relays, deficiencies in the training of ground and air personnel, and the heavy interference of military communications traffic ("conducted with little regard for standard telephony procedures"). I.F.A.L.P.A.'s recommendations are that existing C.W. channels should be retained so that aircraft so equipped may continue to communicate by W.T. direct to air traffic control centres, and that the whole question of changing to H.F./R.T. in Europe and the Mediterranean should be reviewed at an early meeting of I.C.A.O.

On the eighth floor of a Manhattan building is a £180,000 mock-up of the Boeing 707's cabin, designed and made for Boeing by a firm of industrial designers. Seating 98 first-class passengers it is air conditioned, simulates the sound of the engines, has day and night lighting effects and is complete in the minutest detail. Predominant colours are yellow, blue and pink. Note the "passenger service units" above each seat-row, containing call buttons, air louvres, reading lights and emergency oxygen.

CIVIL AVIATION . . .

PANAM'S SUPER-7

MORE than a year ago, when the first DC-7C was a wingless shell in the Santa Monica factory, Douglas and PanAm (who had ordered 33) promised that the first Super-7 transatlantic Clipper service would leave New York today, June 1. At the time of writing, after the arrival of PanAm's third aircraft, N733PA *Blue Jacket*, at London on a proving and demonstration flight, complete with its recently issued C. of A, it looked as though the target date would be met. *Blue Jacket*, having flown from New York (with demonstration calls at Shannon and Prestwick) touched down at London on May 25 at 4.30 p.m.—on schedule to the minute.

PanAm reckon that their 7Cs will be able to operate westbound non-stop full-load services from western European capitals to the U.S.A. on about 90 per cent of occasions—i.e. with the exception of those days towards the end of the year when prevailing westerly headwinds are at their strongest. The 7C is the first aircraft to permit such high-regularity non-stop transatlantic schedules. With its cruising speed of 350 m.p.h., it is, with the 7B, the fastest airliner in service. Not all the PanAm 7C fleet will be used on the Atlantic; those that are will have 72-seat tourist accommodation. The first-class layout seats 58, and removable bulkheads provide for mixed-class accommodation at short notice when required.

The tourist interior was seen to be appointed and styled with pleasing taste, and—as with the PanAm 7B we described in our issue of November 11 last—to a degree of comfort to which no first-class passenger would take exception (the triple chairs are said to cost £300 each). The flight deck, on which B.O.A.C. pilots have now flown more than 100 hours on Douglas test flights, conforms closely to the 7B arrangement: a jump-seat for the engineer between the pilots, and a radio operator's position just behind on the starboard side. The two orange-coloured weather radar-scopes, one for each pilot, are a new feature, and the crew's sleeping-berths are now athwartships instead of along the port side.

B.O.A.C. are due to receive the first of their ten 7Cs on October 5, and will have six in service before the end of the year. Twelve B.O.A.C. engineers have just completed a course at Wright's engine school, and are now studying the airframe at Douglas, Santa Monica. The latest count of 7C orders comes to 112, distributed among 14 airlines.

Footnote: During the 7C's brief stay at London—a few hours after arriving at London the aircraft went on a tour of European capitals—five new Hillman Minxes were drawn up for the photographers between the aircraft's 30ft wheeltrack; no doubt someone will point out that the aircraft's 7,860 U.S. gal fuel capacity is sufficient to drive them all around the world one and a half times.

BREVITIES

"IT seems likely that we will use the Conway," stated Mr. Hans Bongers of Lufthansa recently when asked which engines had been chosen for his airline's Boeing 707 fleet.

* * *

For the benefit of those who spell Qantas with a "u," the airline points out that it is "strictly Non-U."

* * *

Mr. Joseph Taylor, who has retired, has been replaced as B.W.I.A.'s Barbados sales manager by Mr. Hugh Coxe.

* * *

Mr. J. Fenwick, senior signals officer in the M.T.C.A., has been awarded the R.Ae.S. British Silver Medal for 1956 for his work in the field of air traffic control radar techniques.

Permission to increase weekend services to Jersey has been granted to five independents by the M.T.C.A. They are Jersey Airlines, East Anglian, Transair, Air Kruise and Dan-Air.

* * *

According to a Moscow Radio report on May 24 the Tu-104 has flown its first scheduled service, on the route between Moscow and Omsk (about 1,400 miles).

* * *

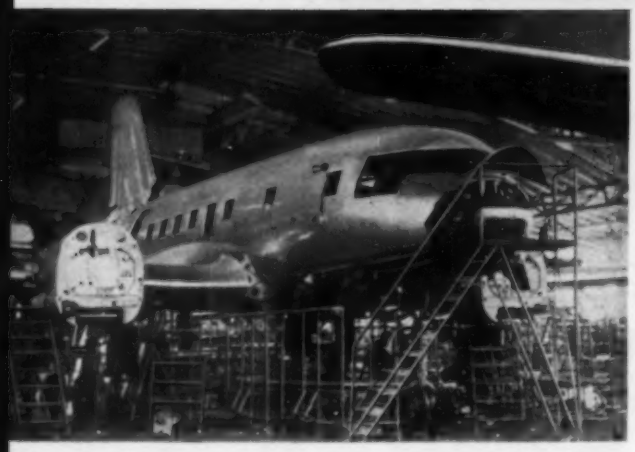
Swissair has increased its Metropolitan order from eight to eleven. The first aircraft of the original order for eight is due to arrive in Switzerland in a few days' time.

* * *

A B.O.A.C. Stratocruiser en route from London to New York on May 19 inadvertently landed at Stretton instead of at Burtonwood. The captain took off again immediately.

The Hunting Group's remarkable mineral-hunting DC-3, now undergoing flight trials from Radlett. It is comprehensively equipped for geophysical survey ("Flight," Feb. 17).

W/C. G. M. McIntosh, O.B.E., who succeeds A. Cdre. J. G. Murray as the M.T.C.A.'s civil aviation controller for Scotland. A. Cdre. Murray is retiring for health reasons.



Licensed construction of the Il-14 in Czechoslovakia is, as shown in this picture, well under way. Built in the "George Dimitrov" factory in Letnvany, the aircraft is being offered for export.

K.L.M. has completed negotiations with three U.S. banks for a £17.85m loan to finance the purchase of its DC-8s, Electras and DC-7Cs.

* * *

The Communist capitals of Sofia and Budapest will be added to K.L.M.'s network next month, subject to final political agreement.

* * *

B.E.A.'s helicopter flights from Nottingham to Birmingham, with a stop at Leicester, will begin on July 2. There will be two services daily in each direction, except for Sundays.

The Czechoslovak Government has asked I.C.A.O. to stop "unlawful balloon action." It complains that Western propaganda balloons are still being sent over its country.

* * *

The national Greek airline T.A.E. has just been bought by the Greek millionaire shipowner Mr. Aristotle Onassis. He intends to operate transatlantic services with new "Douglas four-engined aircraft," and to buy Convairs (presumably 440s) for other routes. Present fleet comprises a DC-4, 14 DC-3s and one Argus.

* * *

Mr. Laurence W. Henderson of Trans-American Air Lines (formerly North American Airlines) said recently: "Last December we wanted Britannias but had to buy five Douglas DC-6s . . . For American 'planes, American banks will advance up to 90 per cent. But they will not advance on Britannias . . . British banks will only advance 40 per cent and want around nine per cent interest."

* * *

PanAm have been told by Russia that discussions on a direct U.S. to Moscow air link would be welcomed. As yet, PanAm have made no comment as the matter is being considered by the U.S. State Department. B.E.A. have still to receive permission from the British Government to operate the services to Russia discussed in Moscow seven months ago (see editorial comment).

RIVIERA TECHNICALITIES

THE Ninth I.A.T.A. Technical Conference at San Remo, Italy, during May was—in terms of attendance (there were 350 delegates) and the size of its agenda—the largest ever. It was also the most important (see last week's *Flight*).

Perhaps the most absorbing discussion—and the one to which the greatest time was devoted—concerned the problems of air traffic control and *en route* navigation.

A.T.C. problems were considered by a committee, of which A. E. Slocombe, British European Airways, was chairman, under two headings: (1) improvements to present systems which might enable them to handle the maximum possible load during the next five years; (2) new systems and principles which must be developed for the first decade of high-speed jet operations in 1961 and 1970.

In addition to a massive factual record, the committee produced and the Conference accepted a series of 26 specific recommendations and conclusions, and urged that "A.T.C. problems can only be successfully solved . . . jointly with the other users of airspace—especially our military friends—and the ground authorities concerned with the provision of air transport services."

Delegates considered that future A.T.C. should be based on an *area* rather than a *route* concept, and discussed at length the computation and presentation of navigational information, stressing the necessity for putting into the cockpit the type of instrumentation which gave the pilot a visual interpretation of his place in the A.T.C. scheme. It was noted that self-contained navigational aids, independent of ground stations, could be made available for civil use in the next few years, but it was pointed out that airlines have not yet had any experience of them; such aids would have to be looked upon as complementary to the present ground-based aids.

The Conference agreed that with the increasing speeds of aircraft it was "unrealistic" to set up A.T.C. control areas strictly within national boundaries. Many of the existing control areas set up on a strictly national basis were extremely small and unsuited to the needs of aircraft operations; aircraft requesting clearance through one had often passed into the next before clearance could be radioed back. Excessively small areas also created unnecessary demands for communications and data.

In dealing with the shorter-range aspects of A.T.C., the Conference made these recommendations for improvement:—

Pending the introduction of automatic communications for continuous position-fixing, present A.T.C. procedures could be improved (1) by use of standard phraseology and procedure in the transfer of data; (2) by speeding by transmissions and recording; and (3) by instituting a standardized position-reporting procedure for pilots.

Regardless of its limitations, primary radar was "one of the best tools" with which A.T.C. had been provided to speed traffic by reducing separation; and I.A.T.A. should do everything possible to encourage the development of an internationally accepted system of secondary radar.

In areas where the frequency of position-reports and navigational accuracy permitted, longitudinal separation minima might be reduced and position-reporting cut. Regional and route-by-route studies of these possibilities were proposed.

In congested areas, all movements should be subject to regulation by air traffic control, even in V.F.R., so that the position of all aircraft will be known. Airlines should experiment with anti-collision lights.

No aircraft should be permitted to come closer than 500ft to another, whether for identification by the military or for any other reason.

Owing to the fact that turbine-powered aircraft would hold at considerably higher altitudes, the development of altimeters capable of providing measurement at high altitudes was necessary so that they could maintain the 1,000ft vertical separation standard.

In order to make the greatest possible use of available airspace, the airlines must continue to urge their governments to eliminate the reserved military zones and institute joint civil and military planning.

Runway requirements for the new generation of aircraft were examined by a committee headed by R. W. Vinal, Pan American World Airways. It was agreed that jet aircraft would not require runways any wider than the present I.C.A.O. standard. In fact, it was held that runways and extensions of 150ft would be acceptable for the new aircraft if equipped with "sideways" or shoulders.

The Conference recommended, however, that where crosswinds of the order of 20 kt are frequently encountered, it might be necessary to provide additional runway or to widen existing runways. In special cases (high snow banks, etc.) wider runways might be needed.

It was agreed that runway lengths and strengths and other aerodrome requirements for jets could not be determined by any general rule, since they would vary for the particular aircraft, the stage-lengths involved, operating practices, etc. Operators must present their needs to local authorities without delay, because at least two years were required between the time the requirements are stated and the runway can be used operationally.

Among the more important additional points made by the Conference in regard to runway requirements were these: Corrections to standard day runway lengths, for temperature and altitude, should be made on a local basis; I.C.A.O. should urgently determine the particular information which should be available at airports respecting the bearing capacity of pavements; attention must be given to surface clearing and cleaning; stopways and clearways would be necessary; the standardized taxiway width should be 75ft and side-ways should be provided to meet surface clearing and cleaning requirements; there was a requirement for high-speed "lead-off" taxiways, even at low density airports; the obstruction clearing slopes already adopted by I.C.A.O. were satisfactory.

Discussion of the braking qualities of wet and icy runways was designed to find out whether methods of measuring runway braking action could be developed to give pilots some idea of the effect of runway conditions on landing distance. The Conference suggested a series of terms, each associated with coefficient of friction, for use of pilots.

Exchanges of views on airport buildings and aprons in relation to turbine aircraft, mechanical conveyance systems and fixed servicing installations occupied four days of discussion by a committee headed by Anton Tolk of K.L.M. Mr. Tolk summarized the discussion in these terms: "In so far as airport buildings and aprons are concerned, it was evident that a number of problems exist, or will exist in connection with turbine aircraft—notably noise, fumes, blast, engine-starting, handling procedures, and apron strength. But a joint effort and continued study and development techniques will find the answers." More definition was possible in considering fixed servicing installations and the Conference agreed that these should include fuel, ground electrical power, telephone, water and lighting—with emphasis on fixed fuel service.

An exchange of views between airlines, manufacturers and governments on structural fatigue problems in aircraft in service and related inspection techniques called for no Conference determinations. However, the chairman of these discussions, Ian Grant-Murray of British European Airways, reported that the problems required considerable expansion of present inspection techniques and might mean supplementing inspection with radiography, ultrasonics, and radio-active isotopes.

The Conference endorsed the report of a committee of which R. Bougge, Scandinavian Airlines System, was chairman, proposing simplified message and communications practices. It also proposed that routine in-flight weather observations be transmitted only by certain specified aircraft, rather than by all, and that a further study be made of ways of rationalizing weather messages. Also suggested were new operational practices to streamline transmission of weather information to aircraft from the ground, and abbreviated phraseology to convey ceiling and visibility.

NOSTALGIA in N.W.4

Hendon Recalls its Aeronautical Fame

THERE is no corner of England more steeped in aviation history than the borough of Hendon in the county of Middlesex. The historic London Aerodrome there—trapped, but miraculously not submerged, by the tide of ever-expanding suburbs—is nowadays a communications and training base shared by the R.A.F., the U.S. Navy and the U.S. Army, whose respective Devons, Super DC-3s and Beavers go about their business without regard for the memories of the Farmans, Blériots and Grahame-Whites belonging to the Hendon of yesterday.

Last week we attended a private showing of a *Flying at Hendon* exhibition, a collection of mementoes, relics and pictures of bygone Hendon aviation now on show (admission free) in Church Farm House Museum, Church End, London, N.W.4, a beautifully restored seventeenth-century building which overlooks the aerodrome from the east.

It was a pleasure to see there some of those who helped to make the history, including Mr. Claude Grahame-White, Lord Brabazon, Sir Frederick Handley Page, Mr. and Mrs. Marcus Manton and Mrs. L. A. Gates. The fact that the whole of aviation's history has happened well within their lifetime is something that never fails to astonish the younger ones among us.

Inevitably, Hendon's aviation history started off with a balloon, and the borough can claim to have put up for the night Henry Coxwell and James Glaisher, who, with three passengers, descended in their Mammoth Balloon (inadvertently, one presumes) upon the nearby village of Mill Hill on August 26, 1862, during a trip from the Crystal Palace to Biggleswade. Hendon's first real aeroplane was built and flown on the site of the present aerodrome by E. I. Everett in about 1908, ending its maiden flight in a tree: but the real beginning of flying at Hendon was in April 1910, when Louis Paulhan wobbled into the air on his successful attempt to beat Grahame-White (who started from Wormwood Scrubs) in the *Daily Mail* £10,000 challenge race to Manchester. One of the exhibits is Grahame-White's own scrapbook of the occasion, open at the telegram Paulhan sent to him before the race: "Hope we arrive together."

Those who grumble at the cost of flying tuition today will be enlightened at an original copy of the syllabus of Grahame-White's famous flying school: £125 for a ten-hour course, even though it was "in the latest type of Instruction Craft." There is something to recall everything: the first British air mail flown from Hendon in September 1911 (the relics include a postcard which says: "Just caught it, but it's *much* too windy for the dear souls to fly anyhow, eh what); the early days of de Havilland and Handley Page; the glory and glamour of the R.A.F. pageants; and the Battle of Britain, in which Hendonians raised £21,870 to buy four Spitfires.

The collection is a credit to the Borough of Hendon, who inspired and brought it together; the exhibits have been gathered from a good many sources (among them *Flight's* archives), and they will not fail to provide nostalgic browsing for anyone with a feeling for aeronautical history.

J. M. R.

Seen inspecting a tapestry embroidered with the signatures of famous pioneer aviators are (left to right): Sir Frederick Handley Page, Mrs. L. A. Gates (widow of the pioneer aviator Richard Gates, and who embroidered the cloth as a young woman), Claude Grahame-White (Hendon's most famous character), and Marcus Manton.

Claude Grahame-White (left) and Lord Brabazon, seen at last week's private showing of the exhibition. They are looking at two drawings of the aerodrome, drawn for "Flight" in 1915 by the late Air Chief Marshal Sir Roderic Hill, who was a frequent contributor.

"Flight" photographs

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Britain's Airline Equipment

IF B.O.A.C. was owned privately by someone like Mr. Onassis, its objects would probably be to make money, and to enlarge so as to make even more money. But as "Favonius" pointed out in your columns on May 18, it is owned by the taxpayers, so that there are many shareholders trying to influence its policy to their own legitimate ends. "Favonius" would like to see it flying British aircraft, even if they are not the best for the job, but to my mind he is not logical in showing why it should do this.

He claims that Britain cannot have prosperous mercantile aviation without a manufacturing industry. I say this is bunk. Of the airlines listed in the recent Civil Aviation edition of your magazine, B.E.A. was the only notable airline outside U.S.A. operating largely with aircraft built in its own country. Brazil and Holland, with strong civil air fleets, use foreign aircraft, and similar examples could be quoted from the marine world.

He jibes at B.O.A.C.'s "red-ink stains" without admitting that these stains were largely due to his own policy of flying British. In 1946 B.O.A.C. had 84 British four-engined aircraft and it lost a lot of money; it is precisely because of this that I said [Correspondence, *Flight*, February 24] that the two calls on the Corporation, to fly British and to make money, can be incompatible.

He implies that criticism of the manufacturing industry is defeatist, which is quite unjust. Fair criticism is the basis of democracy, and far from being defeatist I specifically mentioned my confidence in the Britannia.

He says that the Comet 4 "needs a strong companion." If it must have one, why not the Britannia? But since when has a good aircraft (e.g., Dakota, Viscount) needed a companion? You cannot breed the things.

He pleads for the industry to be given orders for "commercial prototypes," but many people feel that this is just where the industry comes unstuck, and that it has produced too many successful prototypes and not enough aircraft capable of economic operation.

But on some points "Favonius" and I do agree. We agree that the Corporation should buy direct, and we deplore what he calls "the triple-tiered hierarchy of M.o.S., M.T.C.A. and B.O.A.C." And we would both like to see a strong industry. It is in how to obtain it that we disagree; in my view he is trying to obtain it at the expense of B.O.A.C. He places the blame on B.O.A.C. for ordering American, where I put it on the manufacturers for

This 20 gallon per minute pump
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making this necessary. The manufacturers have had some rotten luck, especially D.H., but although I sympathize I do not feel they should be allowed to weaken B.O.A.C.'s position in the competitive field. I still plead, as I did in February, for B.O.A.C. to be given greater freedom, and I wish those who are taking the place of Sir Miles Thomas the same success which he has achieved.

London, W.1. ICARUS.

Flight-Refuelled Airliners?

WHAT is preventing the wide use of Sir Alan Cobham's flight refuelling system by B.O.A.C. and other airlines? Is it *really*, as has been suggested, funk of an airliner flying in formation with a tanker? Sir Alan's system has been widely adopted by the U.S.A.F. and now there is an American Air Force aircraft being flight-refuelled throughout the 24 hours. Maybe the American civil airlines will adopt it soon, so that their jet airliners can become airborne at a more reasonable weight. Then we shall discover, too late, that if the Comet 4s had been adapted for flight-refuelling, we could have had the first non-stop jet airliners on the North Atlantic run.

London, S.W.3. GEOFFREY DORMAN.

Memories of the D.H.9A

IT always inspires a thrill to read about the aircraft we flew in the "first war" and I have followed with pleasure the articles recently appearing in *Flight*.

The subsequent correspondence shows the measure of the interest created, and the letters referring to the D.H.4 and D.H.9 series have held a special interest for me. I had, however, been hoping that someone would write about the D.H.9A, a development of the D.H.9, but powered by the 400 h.p. Liberty engine. [Since this letter was written Mr. J. M. Bruce's article on the D.H.9A has been published; the second part appears in this issue.—Ed.]

The 9A was a splendid aircraft, and received with joy by those who were about to go out to France on daylight bombing. One of your correspondents refers to the D.H.9 as being very much under-powered. I never heard this criticism made. It is true, however, that the D.H.9A, with its greater power, had a superior performance, and would climb, with its warload of three 112-lb bombs, its single Vickers gun in front and twin Lewis guns at the rear, with several hundred rounds of ammunition, to 15,000ft in 50 minutes. Our operating height on service was 17,000 to 18,000ft.

Because of its greater weight, the glide when approaching to land was much flatter than that of the D.H.9, which presented some difficulty at first; but most pilots quickly adapted themselves and became expert at handling this aircraft.

My Squadron—110—was the first (and, I believe, in the event the only) D.H.9A squadron to go out to France; this was in August 1918. We became part of Trenchard's Independent Air Force, with our aerodrome at Bettoncourt, south of Nancy.

The D.H.9As of 110 were presented by the Nizam of Hyderabad, and each plane had the fact proudly recorded on each side of the centre section.

We penetrated, for those days, deep into the Rhineland to bomb such towns as Mannheim, Frankfurt and Kaiserslautern. While we maintained good formation we were either left alone or sniped at from a safe distance by the greatly outnumbering German "scouts" always trailing us; but any straggler was quickly pounced upon, and our casualties were very high.

It was held, however, that the Independent Air Force had achieved its objective in lowering the morale of the Rhinelanders. Undoubtedly we were responsible for quite a diversion from the main German war effort in terms of aircraft and anti-aircraft concentrations.

Sanderstead, Surrey. W. ARMSTRONG.

FORMATION AEROBATICS (continued from page 665)

As early manœuvres become relatively easy, so are the more difficult ones introduced, until the aircraft and pilots alike are being flown to their absolute limits.

A detailed examination of a simple manœuvre, a 180-deg turn, may illustrate the difficulties involved. The aircraft are flying in echelon starboard at about 400 kt, when the leader initiates a turn to port. Each aircraft rolls about its own longitudinal axis until the required 70 deg of bank is attained, and they are in a 5-g turn (Fig. 5). At this stage No. 4, on the end of the line, is flying around an appreciably greater radius than the leader, having accelerated some 15 kt during his couple of seconds taken to apply the bank. When the leader has turned far enough, he starts to roll out. No. 4 has then to close his throttle so as to lose excess speed and maintain his position. If, at this point, the leader decides that he has turned too far, and reverses his bank, No. 4 is apt to slide ahead, fully throttled back. When the formation rolls out of this starboard turn, No. 4 is now travelling more slowly than No. 1 and, being throttled back, is unlikely to be able to get the engine revs soon enough to catch up.

This applies also to the other team members who not only have to juggle their throttles to keep in position, but must avoid using either full power or no power, in order to give No. 4 a chance. Thus, if Nos. 3 and 4 were thrown out of position, a good No. 3 would not heave on full throttle to regain his position, but would leave a few revs in reserve to allow No. 4 to keep up, and they would regain their positions together. As a rule, the leader leaves his throttle set at the revs which experience has shown to be best for the particular routine. On occasions he helps the rest of the team to change formation by judicious use of his throttle, but it is essential that he does exactly the same thing every time the manœuvre is rehearsed.

A good example of this is the roll, changing from line astern to box in the process. Assuming a fairly high rate of roll (necessary in a compact routine, to avoid covering too much ground) it is impossible for the formation to catch up with the leader before the roll is completed, unless the leader throttles back at the start of the roll, and opens up again when the team is in box. This, however, is an exception, and the leader keeps his revs steady most of the time.

For the other pilots, a little anticipation of throttle movements is desirable. This is possible because the leader constantly calls his intentions over the R/T. On take-off he will call "Rolling . . . NOW" and each pilot releases his brakes at the same moment. In the air he calls "Pulling up for a roll to starboard . . . rolling . . . steep turn port . . . wing-over starboard . . . line astern—GO . . . pulling up for loop . . . box formation—GO" . . . and so on. After each change of formation it is helpful to the leader if the last man in position gives a "blip" on his transmit button. He is too busy to speak! Although the R/T is so helpful, it is essential that, if a team member has a radio failure, he can continue round the set routine and change formation in the correct places.

Experience has taught us that the interest of the crowd tends to waver if the landing is included as part of the display. With swept-wing aircraft the landing is inevitably preceded by a fairly drawn-out circuit, particularly if the aircraft are in formation. It is probably better to finish the show with a decisive manœuvre such as a "bomb burst," fly away and return later in the programme for a normal tight break and individual landings.

Each succeeding generation of aircraft has its own peculiar limitations. No jet aircraft swings like a Spitfire, but the Spitfire pilot could slam his throttle and expect an immediate surge of power. Modern axial-flow jets have an acceleration time which is quite acceptable for operational purposes, but seems an eternity to the team member struggling to regain his position! When the Spitfire pilot closed his throttle the aircraft immediately slowed down. A Hunter seems willing to continue at undiminished speed almost indefinitely. Powered controls take much of the physical work out of formation aerobatics, but make it a little more difficult to hold a rock-steady position. I am, however, far happier attempting the more advanced manœuvres in a Hunter than in, say, a Meteor. This is a tribute to the sensitivity of control and extra "urge" available in the former aircraft.

To sum it up, it seems to me that the perfect team—if such a thing could exist—should aim at a complicated routine, involving many artistically executed formation changes; they must never get too far away from their spectators and must strictly preserve the continuity, thus ensuring that there is literally "never a dull moment."

The author of this article. On his Hunter and his helmet are painted the "Fighting Cocks" insignia of No. 43 Sqn.; and his muffler repeats the chequerboard squadron marking.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

New Inspector-General

THE Air Ministry announces the appointment of Air Marshal Sir Walter Lloyd Dawson as Inspector-General of the R.A.F. with effect from July 31 this year.

Air Marshal Dawson was most recently Deputy Chief of Staff, Plans and Operations at S.H.A.P.E., and before that was Assistant Chief of Air Staff (Policy) at Air Ministry. In the immediate post-war period he was A.O.C. Levant until 1948.

O.U.A.S. Annual Dinner

AT the annual dinner of the Oxford University Air Squadron, held at the headquarters in Manor Road, Oxford, on May 18, notable guests included Air Chief Marshal Sir Dermot Boyle, Chief of the Air Staff; Mr. A. H. Smith, the Vice-Chancellor; Air Chief Marshal Sir Guy Garrod; Air Marshal R. L. R. Atcherley; Air Marshal H. L. Patch; Air Marshal Sir Douglas Macfadyen; A.V-M. V. S. Bowling; the Rev. Canon A. S. Giles; and many heads of colleges and senior members of the University. Also present were Col. T. J. Dacey, Jnr., U.S.A.F., commander of the base group at Upper Heyford, and the commanding officers of the Cambridge, London and Bristol University Air Squadrons and of Nos. 600 (City of London) and 615 (County of Surrey) Sqns., R.Aux.A.F.

W/C. G. H. Nelson-Edwards has now been succeeded as Commanding Officer of O.U.A.S. by W/C. M. H. Constable Maxwell who, in concluding his speech of welcome to the guests, announced that the lease for the squadron's present premises, heavily threatened of late, had now been extended for a further 21 years.

Sir Dermot Boyle, replying for the guests, said that the squadron had been formed as a centre of interest in the R.A.F. within the university and that, unlike many of the Air Ministry's schemes, it had worked exactly as intended. In more serious vein he said that the R.A.F. was now concentrating its energies on the deterrent to attack—the V-bombers. These would be constantly kept up to date in relation to new developments, particularly in the form of new radio countermeasures, the use of powered bombs and stand-off bombing.

The supersonic reconnaissance bomber and, later, the ballistic missile would follow them into service. Future wars would be forestalled mainly by such measures, but air defence could not be ignored. More emphasis was to be placed on night fighters, and day fighters would be equipped with radar giving them at least a limited all-weather capability. Early-warning equipment now in R.A.F. use was, he thought, the best in the world, and British chains were tied in with continental systems. Their function was to alert the whole nation and, with the aid of the defences, to give the V-bombers time to get off the ground on their way to their targets.

The P.1, he said, was a great step forward and was well in advance of any threat foreseen for the time at which it would go into service. The gun as an aircraft weapon would disappear "in ten or five years time," and the ground-to-air missile would be introduced into service.

Present strategic planning was centred on the needs of the "cold war," which required flexibility for moving troops to potential trouble spots, and preparedness for the requirements of eventual limited wars. Transportation would be provided by Comets, Britannias and Beverleys.

Mr. A. H. Smith, the Vice-Chancellor, in proposing the health of the squadron, said that the O.U.A.S. was, in his opinion, one of the most valuable influences in the university. Replying on behalf of the squadron, Mr. R. A. Reynolds of Merton College recorded the re-styling and decoration of the bar by squadron members; and victories over U.L.A.S. in squash and golf and over C.U.A.S. in the Hack Trophy competition. Mr. Reynolds remarked that for the first time ladies were present at the annual dinner—and one of them was the C.O.'s secretary, Miss Round, who had given many years of fine service to the squadron.

In her uniform as Air Chief Commandant of the W.R.A.F., the Duchess of Gloucester inspects the guard of honour during her recent visit to No. 2 F.T.S., Hullavington. Her Royal Highness is accompanied by F/L. F. S. Johnson, and the station commander, G/C. R. J. Abrahams.

Another recent royal visit was that of Princess Alexandra to Oakington, where she reviewed the passing-out parade of pilots of No. 5 F.T.S. In this picture Her Royal Highness is being shown a Vampire Trainer cockpit; W/C. D. S. Hoare is explaining details, and in attendance is G/C. J. E. Kirk, station commander.

R.Aux.A.F. Appointment

THE Queen has approved the appointment of G/C. J. M. Birkin as Honorary Air Commodore of the Nottinghamshire units of the R.Aux.A.F. These include No. 504 (County of Nottingham) Sqn., No. 2504 Field Sqn., R.Aux.A.F. Regt., No. 3504 Fighter Control Unit and No. 664 Air Observation Post Sqn. The previous Honorary Air Commodore was Lord Sherwood of Calverton.

G/C. Birkin joined the R.A.F.V.R. in 1938, commanded No. 1409 Meteorological Flight in No. 8 Pathfinder Group in 1944 and later became the first C.O. of No. 571 (Pathfinder) Sqn. He was twice an instructor at the Empire Central Flying School. After the war he commanded No. 504 Sqn. from 1948 to 1950.

Search for a Dragon

IN a quest for a squadron mascot, No. 234 Sqn., based at R.A.F. Geilenkirchen, Germany, is looking for a tame dragon of the type represented in the squadron badge. They would settle for an iguana.

R.O.C. Recruiting

DURING the first quarter of this year 437 men and women volunteered for training with the Royal Observer Corps, including six officers, two of them women, and 431 observers, 83 of them women.

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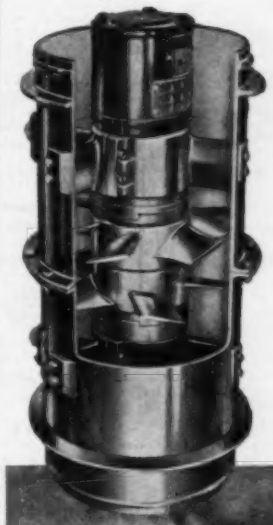

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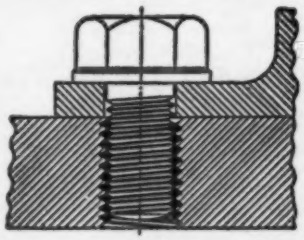

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned application to operate a scheduled air service:

Application No. 789. From Eagle Aviation, Ltd., of Marble Arch House, 32-50 Edgware Road, London, W.2, for a Seasonal Inclusive Tour Service with Viking aircraft in conjunction with Sir Henry Lunn, Ltd., for the carriage of passengers and supplementary freight between London (Blackbushe) and Milan at a frequency of up to seven return flights weekly during the season from May to October inclusive each year, for a period of seven years, commencing 1st May, 1957.

THIS application will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to this application must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the application may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [5304

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PUBLIC ANNOUNCEMENTS

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RESEARCH FELLOWSHIP IN AERONAUTICS

Applications are invited for a Research Fellowship in Aeronautics established by the English Electric Company in the University of Glasgow. The Fellowship is intended to provide for a graduate in Engineering or Applied Science the opportunity to spend a year in advanced study and research in Aeronautics. The value of the Fellowship will be £500 per annum, though consideration will be given to the payment of a higher award to a successful candidate with previous experience in aircraft engineering practice. Tenure will begin on 1st September, 1956. Applications (3 copies), with a statement of experience and the names of three referees, should be lodged, with the undersigned, not later than 23rd June, 1956.

ROBT. T. HUTCHESON. Secretary of University Court. [5296

PUBLIC APPOINTMENTS

MATHEMATICIANS required at various Ministry of Supply Experimental Establishments for work in numerous fields of interest including aerodynamic and structural problems arising in supersonic flight; application of mathematical techniques to control and heat transfer problems of guided missiles; radio propagation; application of high speed computing techniques to fluid dynamics and solid mechanics; etc. Candidates should have or be obtaining a 1st or 2nd class hons. degree. Post graduate research or special experience in any of above fields would be an advantage. Appointment according to age, quals., etc., as Scientific Officer (min. age 21) on salary range £539-£973 (London) £514-£933 (provinces) (superannuable). Forms from M.L.N.S. Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting A 198/6A. [5289

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Write, stating age, qualifications, experience, etc., to **Dept. C.P.S., 336/7 Strand, W.C.2, quoting Ref. 606A.**

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Candidates must be between 21 and 28 years of age during 1956 (up to 31 for permanent members of the Experimental Officer Class) and have First or Second Class Honours degree in physics, chemistry, mechanical or electrical engineering, or mathematics. Candidates taking their degrees in 1956 may apply before the result of their degree examination is known.

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Application forms and further information from the Civil Service Commission, Scientific Branch, 30 Old Burlington Street, London, W.1, quoting number S/128/56. [5302

COMMONWEALTH OF AUSTRALIA
DEPARTMENT OF SUPPLY

Applications are invited for the undermentioned position in the Research and Development Branch, Central Staff, Melbourne, Victoria.

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SALARY: £1,668-£1,888 per annum.

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Application forms obtainable from:
Senior Representative (AP.58),
Department of Supply,
Australia House,
Strand,
London, W.C.2.
with whom applications should be lodged by June 21, 1956. [5307

SENIOR Scientific Officers: Scientific Officers. The Civil Service Commissioners invite applications for pensionable appointments. Interview boards will sit at frequent intervals. The scientific posts cover wide range of scientific research and development in most of the major fields of fundamental and applied science. In biological subjects the number of vacancies is small: individual vacancies exist for candidates who have special knowledge of, or who are interested in palaeobotany, malacology, helminthology, acarology, foraminifera.

Candidates must have obtained a university degree with first or second class honours in an appropriate scientific subject (including engineering) or in mathematics, or an equivalent qualification; or possess high professional attainments. Candidates for senior scientific officer posts must in addition have had at least three years' post-graduate or other approved experience.

Candidates taking their degrees in 1956 may apply before the result of their degree examination is known.

AGE Limits: Senior Scientific Officers, between 26 and 31, but specially suitable candidates under 26 may be admitted; for Scientific Officers between 21 and 28 during 1956 (up to 31 for permanent members of the Experimental Officer Class). Salary (London) Senior Scientific Officers: (men) £1,135-£1,310, (women) £999-£1,220. Scientific Officers: (men) £539-£973, (women) £539-£898. Women's scales being improved under equal pay scheme. Somewhat lower rates in the provinces. Pay and conditions of service are under review.

Further particulars, for which early application is advised, from Civil Service Commission, Scientific Branch, 30, Old Burlington Street, London, W.1, quoting S.53/56 for Senior Scientific Officers and S.52/56 for Scientific Officers. Applications for posts in any branch of chemistry or biology must be made by 30th June, 1956. [5281

PUBLIC APPOINTMENTS

METEOROLOGICAL Office, Scientific Officers. The Civil Service Commissioners invite application for permanent posts. Early application is advised. The duties include research in atmospheric physics, covering the study of cloud structure, synoptic and dynamical meteorology, large and small scale diffusion and turbulence, climatology, and development of instruments. There is a limited number of posts for forecasting work at the more important centres. Successful candidates will be given a course in meteorology before being assigned to a research or forcasting establishment for further training and experience. In some instances candidates with national service obligations can be commissioned in the R.A.F. for forecasting duties at R.A.F. stations. Further information may be obtained from the Director, Meteorological Office (M.O.10), Air Ministry, Kingsway, London, W.C.2.

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Particulars from Civil Service Commission, Scientific Branch, 30 Old Burlington Street, London, W.1, quoting No. S52/56 (Met.). [5301

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PLEASE write in confidence, stating age and giving full details of previous experience to:

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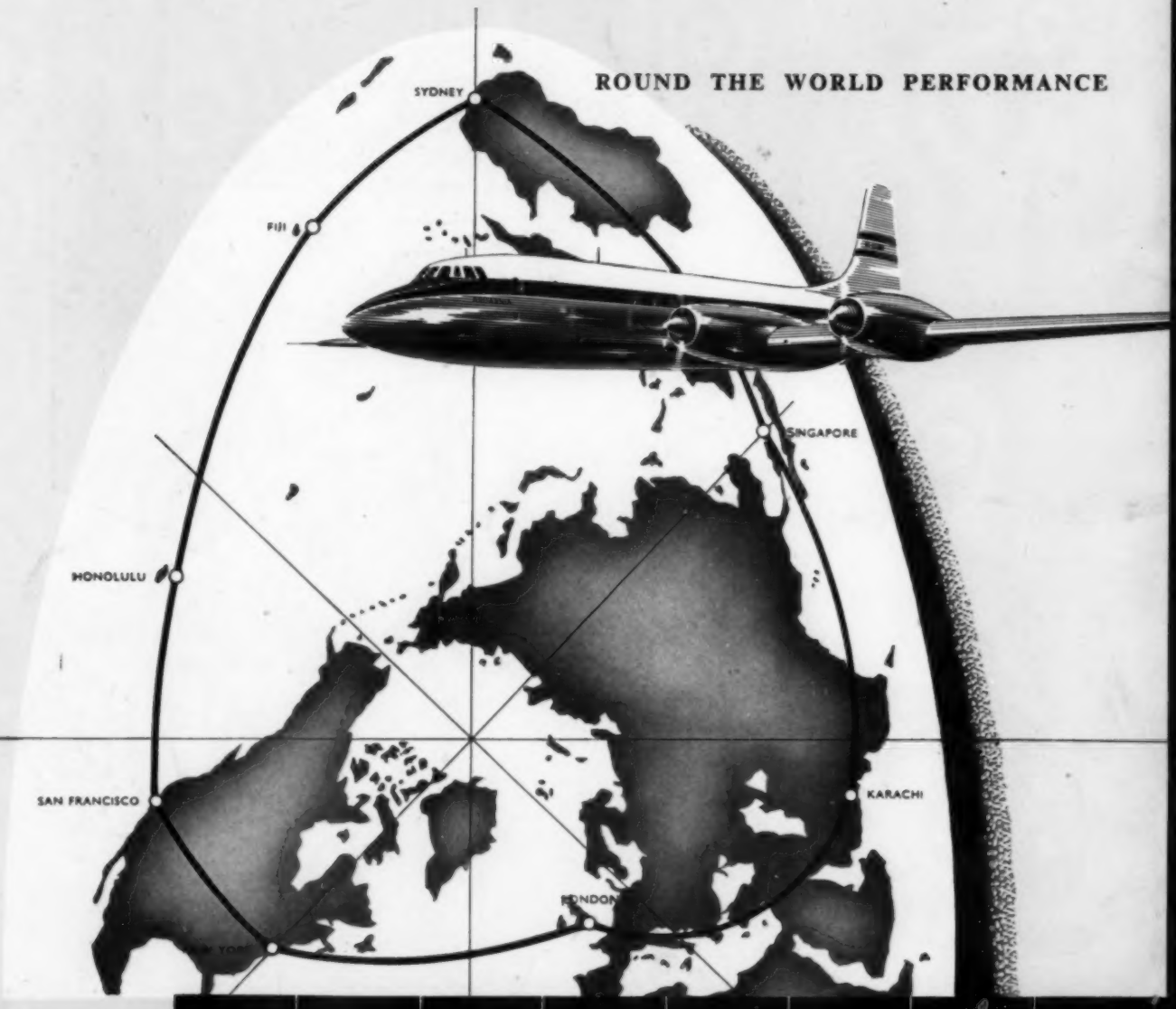

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